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MESENTERIC THROMBOSIS *

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THE valuable contributions to the literature of this subject by Jackson, Porter and Quimby in 1904, Trotter in 1913 and by A. Reich in 1913 and 1914 render its further elaborate consideration unnecessary at the present time. While the monograph of Jackson, Porter and Quimby comprises an analysis of 214 cases observed in the Boston hospitals and gathered from the experience of individual friends, including in many instances the autopsy findings, the monographs of Trotter and Reich add to the analysis of 262 cases reported in the general literature, the results of the ligation of mesenteric vessels in animals. Individual experience is, however, always of value and the writer believes that the wide variability in the extent of the lesion, in its rapidity of development and consequently in its clinical manifestations warrants the report of additional data, although the number of cases which occur in the experience of any one surgeon is necessarily small.

The normal arrangement of the intestinal circulation is well understood. The main artery supplying any segment of the large or small intestine is usually an end artery, while the corresponding vein, if obstructed, is ordinarily without sufficient collateral circulation to avoid serious nutritive disturbances. It is only within the arcade proper that the intestine is provided with adequate collateral circulation, and even in this location the size of the segment of which the viability can be so maintained is necessarily small. Thus, it is common experience that vessels near the mesenteric attachment can be ligated without danger, and in one instance an artery and vein within several inches of the root of the mesentery supplying the ileum, that had been ruptured

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by subcutaneous trauma, were ligated by the writer without subsequent complication. Between the small number of cases in which the collateral circulation may be satisfactorily established and those in which its failure is followed by necrosis, there must be a zone in which the viability of the affected portion hangs in the balance, and in this group, while the collateral circulation may be sufficient to prevent extensive necrosis it may not be adequate to prevent the death of one or more patches of the intestinal mucous membrane, namely, of that part of the intestinal wall which is most remote from the centre of circulation, resulting subsequently in perforation or in healing with cicatricial contraction. Finally the lesion with its corresponding clinical picture may be modified by the more or less rapid extension of the thrombus in either direction until so many vessels are occluded that necrosis becomes inevitable.

While it is unnecessary in those cases in which there is necrosis of the entire intestinal wall to describe in detail the lesion of the resulting peritonitis, it is most important to call attention to the fact, that the thrombotic process may be insufficient to permanently impair the viability of the affected segment. This fact has been satisfactorily demonstrated by several autopsy records, in which the collateral circulation in a large segment of intestine has been satisfactorily established where the formation of the thrombus has been particularly slow, and by the case reported by Martin in which the superior mesenteric vein was found thrombosed with the intestine in many places ecchymotic and congested. The abdomen was closed without further interference and the patient recovered after a stormy convalescence. In this case there was a history of tight lacing on the evening preceding the attack. The possibility of temporary interference with the circulation by small thrombi, rapidly forming but of limited extent, seems to be demonstrated by the occurrence, in the history of many cases, of brief attacks of severe abdominal pain prior to the onset of the final attack in which laparotomy or subsequent autopsy reveals a condition of complete necrosis.

A brief consideration of the etiology of mesenteric thrombosis is justified in view of its close relationship to the diagnosis of this often obscure lesion. It is also most important to emphasize the fact that cases occur in which no satisfactory cause can be elicited. The most frequent causes may be grouped as follows:

(1) The occlusion of a large mesenteric artery by the lodgement of an embolus of cardiac or arterial origin, or from some distant focus of infection.

(2) The occlusion of a large mesenteric artery by the formation of a thrombus *in situ* either from the erosion of the arterial wall or from trauma.

(3) The occlusion of a large venous trunk by the formation of a thrombus due to the erosion of a chronically inflamed intima; to the extension of a small infected thrombus in a portal radical, most commonly associated with acute inflammation of the appendix; to the presence of adventitious toxins in various infectious processes, or to the disorganization of the blood associated with the severe anæmias, diabetes and with the latter stages of the wasting diseases.

The much more frequent involvement of the superior rather than the inferior mesenteric artery is accounted for by the larger size of the former vessel, and by the fact that it arises from the abdominal aorta nearer the heart and at an angle mechanically favorable to the direct passage of embolic material.

The importance of a specific history and the consequent positive Wassermann reaction is self-evident.

In a very considerable proportion of cases, no adequate cause can be discovered. This is observed most frequently in mesenteric thrombosis of venous origin forming a group of cases of special interest for the reason that, although the resulting necrosis is usually complete, the affected loop does not generally exceed 12 to 24 inches in length and, in the absence of any one of the associated lesions just enumerated, the chances of a successful resection are peculiarly favorable. That cases of mesenteric thrombosis not infrequently occur without discoverable cause and in patients with no history of previous illness cannot be too strongly emphasized. While the etiological importance of the group of circulatory disturbances, already mentioned, must always be recognized, the fact that, occasionally, not one can be identified must not be overlooked and must not lead to the positive exclusion of mesenteric thrombosis in the diagnosis of acute and subacute obscure abdominal conditions.

In explanation of the occurrence of these obscure cases only theories can at present be offered. Reich is responsible for the ingenious suggestion that thrombosis results directly from the action of toxic material which, after its absorption by the intestinal lymphatics, passes into the lymphatics of the venous walls and, in that position, indirectly coagulates the blood in the interior of the vessel. The writer wishes to advance the theory that there may be an intimate relation between abnormal intestinal fermentation and the subsequent absorption of the resulting chemical products by both the lymphatic and venous radicals,

leading on the one hand to peritoneal adhesion with the formation of adhesions and on the other to the possible but rare coagulation of venous blood. Pathologically, at least, the presence of organized extensive peritoneal adhesions in patients with no history of a prior peritonitis is not infrequent. The writer recalls one instance in a girl of sixteen, operated for acute obstruction from band formation with a total absence of any prior abdominal difficulty.

In view of its bearing on the etiology of thrombosis of the portal radicals, the writer reports briefly an instance of extensive thrombosis of the veins of the great omentum, adherent in places to an underlying fibroid, reaching to the level of the umbilicus but with no indication of previous torsion or of recent inflammation. The thrombosed vessel, as large as the adult little finger, passed upward superficially to the transverse colon, through the gastrocolic omentum, to the greater curvature of the stomach, where, after being joined by the gastro-epiploica-dextra vein, involved for a short distance to the left also in the thrombotic process, it passed to the right and ceased to be thrombotic at a point near the junction of the superior mesenteric and portal veins. There was no circulatory change in any part of the gastro-intestinal canal. Prior to the operation the patient had had attacks of severe cramp-like abdominal pains. In the course of the supravaginal hysterectomy, the great omentum was ligated below the level of the transverse colon, the thrombotic vessel having previously been incised and the clot cautiously expressed from above downward. Subsequent microscopical examination of that portion of the thrombosed vessel in the amputated omentum showed no abnormality, and bacteriological examination of the clot which was moderately soft and not organized showed no organism. Is this instance of thrombosis, unique in the experience of the writer, to be ascribed to a mechanical factor such as pressure on or trauma directed against the abdominal wall? During the two years that have elapsed since the operation there has been no indication of any further abdominal circulatory disturbance.

The grouping of the clinical symptoms of mesenteric thrombosis into a picture that may be considered fairly characteristic meets with the greatest difficulty. In rapidly forming thrombus involving a considerable part of the intestinal tract, the invasion is sudden and the course most rapid, with evidences of extreme shock. On the other hand, where the thrombosis is of slow formation and the segment of intestine is small, the invasion may be much more gradual and the course may be prolonged. That the individual symptoms also widely vary is seen in the generally accepted classification adopted by Reich and sub-

stantiated by the analysis of 262 cases, in which mesenteric thrombosis is divided into two distinct groups:

(1) A group characterized by the classic symptoms of acute intestinal obstruction in which there is acute circulatory disturbance—pain, vomiting and complete constipation being especially prominent symptoms.

(2) A second type, in which the pain and vomiting are associated with the occurrence of repeated watery stools, occasionally containing blood.

Reich, in his analysis states that diarrhœa occurs in 41 per cent. of the cases and that in 26 per cent. the stools contain blood. He also states that in 16 per cent. the vomitus contains blood.

The source of the watery discharges has proved largely a matter of speculation. Usually their origin has been referred to an abundant exudate from the intestine below the site of the lesion. It is quite possible, however, that the bloody and serous discharges come from the wall of the thrombosed intestine itself and that the intestine directly above the lesion is as much a source of the serous discharge as is that directly below. To be sure, paralysis of intestinal peristalsis in mesenteric thrombosis is commonly ascribed to the affected loop, but that this does not always occur, at least in the early stages, is clearly proved by the interesting fact observed in Case III, in which a typical bismuth stool followed the exhibition of that drug only a few hours before the operation.

While the physical examination of the abdomen is of the greatest importance in a condition in which such diametrically opposed symptoms may occur, it is particularly essential in the second group, in which the diarrhœa, especially if associated with bloody stools, strongly suggests the possibility of a colitis—a diagnosis rendered still more probable if the pain, which, in mesenteric thrombosis, is usually atypical in both its location and character, happens to be paroxysmal and referred to the course of the large intestine.

Fortunately the character of the physical signs is much more constant than that of subjective symptoms. They are chiefly the result of peritoneal irritation in some part of the abdominal cavity, depending upon the position of the affected intestinal loop. They comprise diminished and at times asymmetrical respiratory movement of the abdominal wall, rarely visible peristalsis (especially in the subacute cases), equally rare localized meteorismus, usually localized tenderness, and the all-important symptom of muscular rigidity which, even in mesenteric thrombosis of limited extent, is apt to be more diffuse than localized.

In the acute type the rigidity usually obscures a tumor, while in the subacute type, the rigidity is less intense and a tumor is occasionally felt. Occasionally the fluid in the peritoneal cavity is sufficiently abundant to give a dull note, especially with the aid of auscultation. Shifting dulness has also been obtained. The writer does not consider, however, the movement of the patient's body necessary to elicit this symptom in this or in any other form of infectious peritonitis advisable, on account of the liability of the spread of the infection to distant parts of the peritoneum.

The frequency with which the affected loop lies in the pelvis emphasizes the importance of a rectal examination. In addition to the localized tenderness a sense of fulness is sometimes elicited, and in these subjects, on bimanual examination, an actual tumor may be felt. The leucocyte count is also of considerable importance. As in other infectious processes in the peritoneum, an increase in both the general and the polymorphonuclear count is usually obtained. Together the physical signs are those of a spreading peritonitis and resemble closely the physical sign associated with an infected appendix, a duodenal perforation, an infected gall-bladder or an acute pancreatitis, according to the position of the affected loop. Finally, the physical signs differ not only in location but in their intensity. In extensive thrombosis of rapid formation the abdomen may be markedly retracted and the rigidity is diffuse and intense.

Treatment.—Operation is indicated in all cases uncomplicated by serious or advanced associated visceral changes. The presence of a diffuse and persistent (although not necessarily intense) abdominal rigidity, alone, warrants for prompt exploration. The difficulty in diagnosis and the consequent likelihood of confusing this condition with some more common infectious abdominal process, makes the operation largely exploratory, and in the larger number of cases the actual condition is recognized only after the opening of the abdomen. When the peritoneal cavity is opened the presence of a dark-colored if not actually bloody fluid almost immediately excludes either an infected appendix, a gastroduodenal perforation, or an acute cholecystitis. A fluid of this character is usually associated with some form of intestinal obstruction due to circulatory interference. The incision should then, if necessary, be sufficiently enlarged to permit the exploration of the entire intestinal tract, beginning preferably at the ileocæcal junction. It is not always easy to distinguish the early changes indicative of thrombosed intestine. The color changes are not always marked and the smooth glistening ap-

pearance of the serous coat may remain unimpaired for some time. On this account some observers prefer postponing the operation to the second or third day after the invasion. Such delay, however, the writer considers inadvisable. Instances of this kind are very uncommon and, when they do occur, ordinarily indicate the involvement of a very considerable portion of the intestinal canal, leaving no normal intestine for comparison. Such extensive thrombosis, it is needless to add, indicates the immediate cessation of the operation. Theoretically, it is possible to conceive of a mesenteric thrombosis in which the establishment of the collateral circulation in a portion of the affected intestine would permit a successful resection of the remainder. Owing to its rarity however, such a possibility need not enter into the question of early operation.

When the nature of the lesion has been determined further measures depend entirely upon its extent. In general resection of the affected intestine and as much on either side as is necessary to insure the viability of the divided ends, followed by the restoration of the continuity of the intestinal canal, is the treatment of choice. Reich has grouped the conditions which preclude the possibility of successful resection as follows: (1) portal thrombosis; (2) multiple infarcts; (3) infarcts of the descending colon and sigmoid; (4) extensive infarcts including those with no sharp line of demarcation. Any one of these conditions, it is quite evident, makes it hopeless to continue the operation beyond the exploratory stage.

In their absence an effort to relieve the patient is entirely justified. If the condition of the patient is good it is generally agreed that resection, followed by some form of anastomosis, should be carried out. Such a procedure, however, may require too long a time in advanced cases, especially when peritonitis has developed. Under such circumstances the operation may be terminated, after the removal of the necrotic intestine, by leaving the divided ends of the intestine in the wound and adding the anastomosis as soon as it is warranted by the improvement in the general condition of the patient.

The methods of re-establishing the continuity of the intestinal canal do not differ materially from those ordinarily in use after resection of strangulated intestine from any cause. Lateral anastomosis is always the operation of choice where the divided ends are of unequal calibre, as between the large and small intestines, as well as where one or both are distinctly œdematous. Ordinarily such œdema should preclude the division of the intestine at that point, but the extreme length of the infarct may compel the taking of such a risk in order to avoid the

sacrifice of too large amount of intestine. How large an amount of intestine may be successfully resected is naturally uncertain. Reich, however, refers to the successful resection of MacGuire of 336 centimetres of the ileum. In cases in which the small extent of the infarct enables the resection to be carried out in small intestine unquestionably healthy, an end-to-end anastomosis is not contraindicated. The comparative value of these different methods is difficult to establish owing to the small number of successful cases. In Reich's tabulated list of 18 recoveries in 91 operated cases anastomosis was effected in one by the end-to-end method by suture, in seven by the end-to-end by button, in three by the side-to-side by suture, and in two by the side-to-side by button, while in four the anastomosis was secondarily re-established after primary resection with the suture of the divided ends in the wounds by the end-to-end suture method. This is the method of choice advocated by Jackson, Porter and Quimby. The fatal cases included 20, in 13 of which a resection with primary anastomosis was done as follows: By the end-to-end suture method, 4; by the end-to-end button method, 4, and by the side-to-side suture method, 5. Resection with secondary anastomosis was done in 7 cases.

A comparison of the methods employed in the successful and fatal cases, respectively, is without value for the reason that the conditions, especially those relating to the age of the patient, the extent and duration of the lesion, and the associated peritonitis, differ widely. Comparison of the methods employed in the successful cases is interesting in that it shows that the post-operative complication of fecal fistula has occurred, irrespective of the method adopted, as follows: In one case of resection followed by end-to-end-suture method (the only case so treated), there was a fecal fistula. It also occurred in 3 of 7 cases where the anastomosis was established by button, in 1 of 3 cases of side-to-side-suture method and in 1 of 2 cases where the lateral anastomosis was established by button. Even in the 4 cases in which secondary anastomosis was made a fecal fistula developed in one and required two attempts to effectively close it. This latter method is especially recommended by Jackson, Porter and Quimby because it minimizes the risk of a comparatively prolonged operation as well as the post-operative risk of leakage at the point of suture from the extension of the thrombosis. That this may occur, even when at the time of resection the arteries divided in the mesentery spurted, is well demonstrated by the case of Weil, in which autopsy showed a condition of necrosis in the sutured ends of jejunum which at the time of operation had been unquestionably viable. To sum up, secondary

anastomosis is indicated (1) when the serious condition of the patient demands the completion of the operation in the shortest possible time; (2) where the line of demarcation on either side of the infarct is not sharply defined; (3) where the extreme length of the infarct for reasons already mentioned warrants the division of the intestine at a point which may be œdematous, (4) where the infarct does not involve the upper part of the jejunum. Should the lesion involve this part of the intestine it is self-evident that a primary anastomosis can alone preclude the rapid loss of strength which would follow the establishment of an artificial anus. Kölbing's case is an illustration in point. The infarct involved the beginning of the jejunum so that after its resection an end-to-end anastomosis was impossible on account of the short length of the duodenal end. This was accordingly closed and the continuity of the alimentary canal established by an anterior gastro-enterostomy. The patient made a brilliant recovery, suffering only from a temporary distention of the stomach, which was relieved by lavage.

Conversely, immediate anastomosis after resection may be done in cases where there is a sharp line of demarcation, where the infarct does not exceed ten or twelve inches in length, where the infarct involves the ileum and where the general condition of the patient warrants the necessary extension of the operation. In every case of primary anastomosis, post-operative leakage is to be avoided, by excising well beyond the limit of normal circulation, by reinforcing the line of anastomosis if possible with an omental flap, and by leaving the sutured loop approximately near the anterior abdominal wall, a short non-rigid drain being inserted to its immediate proximity, so that in the event of leakage, the discharge will be conducted away from the peritoneal cavity.

While post-operative leakage is to be feared more than any other complication, leading either to a fatal peritonitis or to the formation of a fecal fistula, other important post-operative complications have been observed. Thus Codman reports an instance of acute gastro-mesenteric ileus, which was relieved by lavage and posture. Instances of acute obstruction from adhesions, of the retention of the button used in the establishing of the anastomosis, of the formation of a gradually shrinking mesenteric tumor from the swelling of the sutured mesentery, of parotitis and of the occurrence of bloody stools. These different complications occurred in some of the successful cases of resection. Most of the fatal cases in Reich's statistics died shortly after the operation, and in all but a very small number autopsy showed an extension of the pre-operative peritonitis.

The late results in the successful cases of resection should be investigated. Where the cause of the thrombosis cannot be discovered, or where the thrombosis is the result of some vascular lesion which persists necessarily after the operation, a recurrence does not appear at all unlikely. In the three cases herewith reported, one is well and strong without indication of abdominal or other trouble at the end of two years, a second at the end of 20 months, and in the third 10 months only have elapsed since the operation.

Of the successful cases collected by Reich, the condition of Delatour's patient three and one-half years after the operation was entirely satisfactory. There had been no recurrence of any abdominal symptom. An equally favorable condition of the patients of Drs. Ashley, Green and Codman can be reported almost four years after the operation. During that time, however, Dr. Green's patient has had a localized inflammatory process in the apex of one lung which has entirely disappeared. I am greatly indebted to these gentlemen for their kindness in permitting me to include their interesting results in this paper. Although the cases are too few to draw any definite conclusion, the prospect of a permanent cure seems to be quite favorable. The history of the cases herewith reported follows.

To the successful cases reported in the table of Reich must be added Tosatti's case which has since been published, in which a portion of thrombosed jejunum, developing after the removal of an infected appendix, was resected, followed by immediate end-to-end-by-suture anastomosis. Recovery was complicated for a time by the persistence of a small intestinal fistula. Cases by Davis and Weil, abstracts of which follow, have also been reported since Reich's publication.

CASE reported by DAVIS: Female forty-five. Five years ago a similar attack of between 2 and 3 days' duration was successfully treated by morphine and laxatives. Two years ago there occurred a shorter and less severe attack.

For days before admission patient suffered from general though not severe abdominal pain. On the first day of menstruation the pain became severe and later paroxysmal. The pulse increased in frequency and the temperature became subnormal. The abdomen was tympanitic and there was tenderness in the lower left quadrant. The patient was in shock and her condition suggested strongly an ectopic pregnancy. On the following day, there was vomiting and the tenderness was more marked and was associated with slight rigidity. On the evening of that day an enema brought away a bloody fluid result. The pulse was 130, the temperature 96. The general leucocytosis was 35,000. There was visible peristalsis and signs of fluid in the flanks. The abdomen was distended. Vaginal examination was negative.

Operation about 40 hours after invasion. Under ether, the peritoneal cavity was opened through a 3-inch, median, suprapubic incision and 10 ounces of

bloody fluid evacuated. A loop of small intestine, about 18 inches in length, of rigid consistence and of a deep purple color, was resected. Its mesentery was thickened with vessels distinctly thrombosed. The line of demarcation was sharply defined both above and below. The divided ends of the intestine were brought into the wound, Mixter's tubes being inserted and left in place for 5 days. The intestinal discharge caused considerable irritation of the skin. Two weeks later an end-to-end anastomomis was done, a drain being inserted to a small abscess which was found at the point of mesenteric ligation. Patient recovered without further complication.

CASE reported by WEIL: Female fifty-two. History of obstipation for three years. Invasion sudden with general abdominal pain and vomiting. Abdomen was soft with tenderness and resistance over the bladder and left pelvic brim. There was a slight distention. On vaginal examination there was a sensation of a cylindrical body running from right to left and exquisitely sensitive. An enema brought away some fecal particles but no blood. There was no sign of ascites. The pulse was 90 and the temperature was normal. Immediate operation.

On opening the peritoneal cavity a large amount of serosanguinolent fluid was found. A loop of small intestine of at least two feet in length and of bluish-red appearance was exposed. It was separated both above and below by a sharp line of demarcation and was without peristaltic movement. The mesentery was œdematous and its veins were thrombosed. The proximal intestine was contracted. The necrotic intestine was resected and an ileo-colostomy with the transverse colon was done. The patient recovered.

Through the kindness of Dr. J. H. Wheelwright, the following case of mesenteric thrombosis treated successfully by him, is herewith reported, the details of the history being furnished by my former house surgeon, Dr. O. C. Pickhardt.

CASE I.—Female, aged fifty-seven, single, was operated on for a right femoral hernia 18 years ago. A second operation was done 15 years ago for a right ovarian cyst. At that time the appendix was removed. A third operation was done 9 years ago for numerous ovarian cysts of various sizes.

Patient has had bad varicose veins as long as she can remember which have never ulcerated. A year and a half ago patient had a bad fall, striking abdomen against the kitchen floor, and to this accident the present trouble is attributed.

From time to time has suffered from soreness in the lower abdomen in the region of the cicatrices. Several days prior to the invasion of the present attack, this soreness had been felt. The acute invasion occurred shortly after eating several prunes, with very acute pain above the level of the navel. The pain was shooting and continuous in character and radiated from right to left. Very shortly it could be felt working its way down the midline to the lower abdomen. The pain continued with occa-

sional griping exacerbations up to the time of operation. It was so severe that it could not be controlled by morphine. Two hours after onset, vomiting occurred. The bowels had moved normally a few hours before the attack began, and thereafter, prior to the operation, only with an enema and without sign of gas or blood.

Three hours after the invasion, on physical examination, the whole abdomen was found tender, especially in the midline midway between the navel and symphysis. There was symmetrical rigidity of both recti at the point of maximum tenderness. No mass could be felt and there was no distention. Sounds of active peristalsis were heard over the entire abdomen. Rectal examination was negative.

Twelve hours after the invasion a second physical examination was made, and a small, tender, movable mass was felt just to the right of the midline below the navel, which gradually became larger and more tender. Four hours later there was beginning distention and the mass could be distinctly felt through the rectum.

The patient looked very ill. The pulse was 120, temperature 103°, and respiration 28. The blood count was not taken. The vomiting had been repeated but there was tenesmus.

Operation (18 hours after invasion) by Dr. Wheelwright, Dr. Pickhardt assisting.—Under gas and ether anæsthesia the peritoneal cavity was opened through a six-inch median incision and a pint of dark bloody free fluid was found and removed. About three feet from the ileocæcal valve a loop of small intestine, 15 inches in length, of a dark purple color and free from any adhesions except those of fresh fibrin, was found. It was separated from the intestine above and below by a sharp line of demarcation and presented small areas of focal necrosis without perforation. The attached mesentery was markedly infiltrated and all the veins were filled with thrombi. No pulsation could be felt in the mesenteric vessels. The necrotic intestine was excised, leaving two inches of viable intestine on either side and an immediate end-to-end-by-suture anastomosis done. The abdomen was somewhat distended after the operation, but on the second day gas was expelled, again in larger quantities on the fourth day, and on the eighth day a normal, large, solid movement occurred without the aid of catharsis. The patient recovered without further incident.

Through the courtesy of Dr. J. W. Jameson, the following case is herewith reported.

Case II.—Male, twenty-two, single. Referred to Dr. Jameson by Dr. L. R. Williams. Past history negative until several

months ago, when an attack, similar but less severe than the present, occurred, lasting 24 hours. The present attack began 34 hours before the admission of the patient to the Presbyterian Hospital, after eating a hurried meal, with severe sharp pain in the vicinity of the umbilicus increasing in intensity, which, after several hours, was referred to the lower part of the abdomen. It continued without intermission and was so severe that it was not relieved by morphine. Soon after the invasion vomiting occurred, the vomitus consisting at first of food, then of bile-stained mucus. The bowels, ordinarily constipated, moved several times with catharsis, but no blood was noted in the stool. On the day of admission to the hospital, the vomiting continued and was projectile. At no time was blood noticed in the vomitus.

Physical Examination.—The patient looks sick. The face is flushed and the tongue is dry and coated. The pulse is 144, respiration 36 and the temperature 101°. The abdomen is slightly distended, without respiratory movement, and is generally tender, the tenderness being most marked below the level of the umbilicus and on the right side in which latter location the rigidity is board-like. There is dulness in both flanks. Abundant peristaltic sounds can be heard over the entire abdomen. On rectal examination there is tenderness on both sides.

The general leucocytosis is 36,000, the polymorphonuclear is 90 per cent.

Operation (36 hours after invasion) by Dr. Jameson.—Under gas and ether anæsthesia, the peritoneal cavity was opened through a two-inch " McBurney " incision and about two quarts of dark bloody fluid was removed. Examination of the appendix was negative. On further examination of the adjacent ileum, a loop of black intestine about 14 inches in length and two feet from the cæcum was brought into the wound after making a four-inch median incision. The necrotic intestine was swollen and spongy with a sharp line of demarcation both above and below. The mesentery was black and swollen and no pulsation could be felt in its vessels. The gangrenous intestine was excised at a distance of two inches on either side of the line of demarcation and an end-to-end-suture anastomosis added. There was no bleeding from the thrombosed veins of the divided mesentery. After the insertion of a cigarette drain to the region of the mesentery, both abdominal wounds were closed in the usual way.

There was no post-operative vomiting and except for moderate distention the patient's condition was entirely satisfactory until the sixth day, when a fecal fistula developed through which the entire intestinal contents were discharged. Ten days after the first operation, the abdomen was again opened. The divided ends

of the intestine were separated by a considerable interval and there was no evidence of any previous suture except in one place on the mesenteric border. There was an abscess containing a half ounce of pus below the site of the anastomosis. The open ends of the intestine were then closed by inverting with purse-string suture, and a lateral anastomosis was done at a point lower down. A rubber tissue drain was inserted and the wound closed with strong retention sutures. The patient rallied well after the operation and except for the persistence of a purulent discharge through the lateral incision for two weeks made a satisfactory recovery. Recovery was also complicated by a left femoral phlebitis.

Two months after the first operation, patient suffered from an attack of intestinal obstruction. On opening the abdomen through a left pararectal incision, the small intestine was found to be constricted by numerous adhesions and in one place near the anterior abdominal wall it was definitely kinked. The obstruction was relieved and the patient has been well since.

CASE III.—Male, sixty, physician. Many years ago patient had typhoid fever complicated with a right femoral phlebitis. With this exception he had always enjoyed good health, although latterly showing a moderate degree of arterial sclerosis with hyaline and granular casts in the urine. Two days before admission to the hospital, in the evening after dinner, while taking a stroll patient experienced abdominal discomfort with a feeling of nausea. Earlier in the day he had carried two moderately heavy dress suit cases and thought that this might have caused some temporary indigestion. On the following day the discomfort continued and patient was unable to retain any food in his stomach. Notwithstanding the usual remedies for an attack of "indigestion," the symptoms continued unabated and later in the day pain developed, referred at first to the entire abdomen and later shifting over to the right side opposite the navel. After a restless night and with pain alleviated by an injection of morphine, patient travelled all day from Buffalo to New York where he was seen by the writer about 48 hours after appearance of the first symptoms. The bowels during this time had moved several times and twelve hours before the operation patient had had two formed characteristic bismuth stools, having taken that drug for the relief of what at the time he considered was an attack of functional disturbance of the intestine.

Physical examination showed an abdomen free from distention, with tenderness and rigidity well marked on the right side opposite the level of the navel. There was diminished respiratory movement of the abdominal wall. The pulse ranged between 120

and 130 but the temperature was not normal. The general leucocyte count was 25,000 with a polymorphonuclear count of 95 per cent.

Operation (50 hours after invasion) by Dr. Eliot.—Under gas and ether anæsthesia the peritoneal cavity was opened through a McBurney intermuscular incision, and a considerable quantity of amber fluid found near the parietal peritoneum. The appendix was normal. Exploration of the adjacent ileum, however, showed a purple loop of 14 inches in length separated from the healthy intestine both above and below by a sharp line of demarcation of which the lower extremity was about ten inches from the ileocæcal junction. The necrotic loop was carefully withdrawn into the incision, which had been previously extended in both an upward and downward direction, and resected, the line of division below passing through the intestine two inches from the ileocæcal junction. The veins in the attached mesentery were extensively thrombosed and no pulsation could be felt in the mesenteric vessels. The resection was followed by immediate end-to-end-by-suture anastomosis, and after the removal from the pelvis of a considerable quantity of dark-colored bloody fluid and the insertion of a cigarete drain the abdominal wound was closed.

The patient recovered from the operation and for 24 hours was in excellent condition, the pulse ranging around 120 without distention of the abdomen and without any material discomfort. During this time there was passed a quantity of gas from the bowel. At the end of this interval there was a sudden change. The patient was seized with intolerable abdominal pain which could not be controlled by morphine and which caused him to cry out. The wound was immediately reopened and the pelvis was found to contain an abundant quantity of intestinal contents. The anastomosis was tight and well sealed with plastic exudate over the line of suture. Further exploration showed the intestinal contents to issue from a perforation about six feet from the ileocæcal junction in an area evidently the site of thrombosis. This was closed and the pelvis drained, but the patient died 8 hours afterwards, the abdomen having become extremely distended. Microscopical examination of the resected intestine showed extensive venous thrombosis.

Case IV.—Male, thirty-eight, referred by Dr. Bogert. Patient has always enjoyed the best of health. A farmer by occupation he has led an out-of-door life under excellent hygienic conditions. He is of athletic build and gives the impression of being an unusually strong man.

On June 23, between 9 and 10 A.M., and one hour after the

usual daily movement of the bowels, patient was seized with abdominal pain. This was referred to the entire abdomen and was equally intense on both sides. It was not increased by respiration nor movement of the body. It was dull, constant and persistent. The patient was not sufficiently ill to be confined to bed and went up and down stairs, lying down occasionally on the lounge. There was no nausea or vomiting at any time during his illness. At night the pain, still without definite location, was sufficiently severe to require morphine, by which it was relieved. On the second day of his illness, the pain continued and there were several discharges of small amounts of blood from the bowel. A high oil enema was given and brought away about a pint of dark-colored blood. There was no further discharge of blood from the bowels or of gas or of any kind of movement until after the operation.

On the third day, the pain still continuing, the patient was brought to the Nassau Hospital and seen by the writer for the first time. The jolting of the ambulance increased the pain but after his arrival at the hospital the pain became less severe and almost disappeared. During the entire three days the pulse had not exceeded 80 nor the temperature 100° and, just prior to the operation, the pulse was 68 and the temperature a fraction above 99°.

Physical examination showed no sign of circulatory disturbance. The patient looked well and there was no indication of any serious illness whatever. Examination of the abdomen showed diminished respiratory movement on the right lower quadrant and at a point opposite the level of the navel, on the right side, and above the usual location of the appendix there was decided tenderness and rigidity. A rectal examination elicited tenderness on either side. No tumor was felt either through the abdominal wall or through the rectum. No leucocyte count was taken.

Operation (60 hours after invasion) by Dr. Eliot.—Under gas and ether anæsthesia the peritoneal cavity was opened through a mid-incision between the navel and the pubis, and a considerable quantity of bloody fluid evacuated. The appendix was normal. About two feet from the ileocæcal junction a necrotic loop of small intestine, about 20 inches in length, was withdrawn from the pelvis into the abdominal wound. There was some odor but no perforation. The line of demarcation was distinct both above and below. The veins in the attached mesentery were thrombosed and no pulsation could be felt in the mesenteric vessels. The necrotic intestine was resected through a point 6 inches distant from the lines of demarcation with immediate end-to-end-by-suture anastomosis, and the wound closed after saline

cleansing of the pelvis and the introduction of a small rubber tissue drain just beyond the parietal peritoneum.

The patient's recovery was prompt and without complication. He has had no further trouble since the operation, but tires more easily at his work. At present, 22 months after the operation, the patient's health is excellent.

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A REPORT UPON ONE CASE OF SPLENECTOMY *

By Charles L. Scudder, M.D.
of Boston, Mass.

Splenic Anæmia. Splenectomy. Mesenteric Thrombosis. Resection of Intestine. Death.—A Russian cap-maker, eighteen years old, entered the Massachusetts General Hospital on April 26, 1914 (hospital number 195177).

Family History.—Mother living and well, but subject to nose-bleeds lasting from 5 to 15 minutes, about every 3–6 weeks. The oldest brother has the same kind of nose-bleeds as the mother. The grandfather on the mother's side also had the same kind of nose-bleeds. There was no family history of bleeding on the father's side. There were no bleeders in the family or ancestors. Four brothers and two sisters are living and well.

Personal History.—No rheumatism, sore throats, jaundice or malaria. Has had three attacks of bleeding as follows:

First, when eight years old had a swelling in the right hypochondrium the size of a cocoanut, with pain and question of fever. This had to be opened within a week, and "one-half a pail of blood and white material was obtained." Remained in bed for three months because of weakness. No more bleeding or ecchymosis, but one year later a lump in the left side under the ribs began to appear and within one month reached its present size, remaining the same until now. Dull pain limited to the tumor mass has continued.

Second, when fifteen years old suddenly and without cause had bleeding from nose and mouth, ecchymosis over the body. The nose was packed but the bleeding continued 12 hours. He remained in bed for 3 weeks and did not work for 3–4 months.

Third, one week before entrance to the Hospital he was feeling all right. He rode a bicycle and got very heated. During the night his nose began to bleed, but stopped by morning, when mouth began to bleed and bled all the week, although the patient kept at work. One day after onset his arms and legs became black and blue, but this did not last. He gave up work at the end of the week because of weakness, and, his nose beginning to bleed again, he came to the Accident Room for treatment. Nose was packed and he was sent to the ward for study.

* Read by title at the Meeting of The American Surgical Association, in June, 1915.

Physical Examination.—Poorly nourished and fairly developed boy, very pale. Skin bluish tint, dry and harsh, with minute ecchymotic spots over the body, pin-head in size. Many large ecchymotic areas bluish black in color. On left shin is such a spot with raised hard lump in the centre whose crater is yellowish-white. Many of these areas have hard nodules in the centre which are not raised. Scleræ bluish. Mucosa very pale. Tongue clean. Teeth sound. Slight pyorrhœa. Throat pale, tonsils slightly enlarged. Glands: Chain of small glands (nodes) down side of left neck and also in left axilla. Heart: Apex seen and felt in fourth space. Sounds regular, fair quality. One rough, blowing systolic murmur heard at third space left, also heard throughout whole precardia. $P_2 > A_2$, and positive. Pulses equal, fair volume, low tension walls not felt. Chest barrel-shaped. Whole right chest seems dull. Flatness, diminished breathing and fremitus at the base. A few fine râles on deep inspiration. Abdomen: Large, bulging on sides, lax, tympanitic, no dulness in flanks, and no shifting dulness. To the left of the median line below umbilicus, extending almost to pubes, there is a hard mass size of a large plum, slightly tender, movable laterally in abdominal wall. Liver dulness from fifth rib to costal margin. Edge not felt. Spleen extends 14 cm. below costal margin in the nipple line, easily palpable and movable, notch felt at costal margin, non-tender. Kidneys not felt. No costovertebral tenderness. Rectum: No mass in the pelvis.

X-ray of chest May 5. Several small dense white glands scattered about lung roots, and markings running toward apices. Otherwise chest negative.

Urine: Cloudy; 1030 to 1018; no albumin; no sugar; acid; no blood; urates rare; occasional red blood-cell.

Blood: Wassermann negative.

April 26: white cells, 8000; hæmoglobin, 35 per cent.; red cells, 2,980,000. Smear: Neutrophiles, 84 per cent.; small mononuclears and large mononuclears, 12 per cent.; eosin, 1 per cent.; transitionals, 3 per cent. Reds, marked achromia. Variation in size and shape. No polychromatophilia or blasts. Blood platelets much reduced (two seen).

April 26: Transfusion of 600 c.c. of blood brought hæmoglobin from 35 per cent. to 50 per cent. Additional transfusion of 150 c.c. of blood brought hæmoglobin from 50 per cent. to 55 per cent.

April 26: Coagulation time 10 minutes 30 seconds.

April 27: Coagulation time 4 minutes 30 seconds.

April 27: Blood cultures all sterile.

May 7: Hæmoglobin, 55 per cent.; white cells, 3800; red

cells, 2,536,000. Smear: neutrophiles, 63 per cent.; small mononuclears and large mononuclears, 33 per cent.; eosin, 1 per cent.; transitionals, 1 per cent.; megaloblasts, 2 per cent. Achromia. Slight variation in size and shape. One megaloblast.

May 27: Hæmoglobin, 58 per cent.; white cells, 3800; red cells, 2,800,000; neutrophiles, 55 per cent.; basophiles, 45 per cent. Blood plates rare. Coagulation time 5 minutes. Stools markedly positive for guaiac test.

On May 22 bleeding started again from nose and stopped without packing after a short time. The family consented to operation for the removal of the spleen, and preparation was started. There was no further bleeding.

On May 29, exploration under gas and ether anæsthesia showed no free fluid in the abdomen. The abdominal incision oozed more than normally, but not more than usual in an anæmic individual. The spleen was secured by multiple adhesions to the parietal peritoneum, omentum, transverse colon, and gastrocolic omentum. The adhesions were divided and the spleen removed with practically no loss of blood, except for a slight back oozing from the spleen.

The patient did well following the operation. His temperature gradually came down, and he was very comfortable and happy. He looked better and felt better than before the operation. On June 5 the wound was clean and solid.

June 7 he began to have cramp-like abdominal pain of short duration, relieved by enemata. The abdomen was soft and he was sleeping soundly. The abdominal pain increased in frequency and severity and on June 11 the patient appeared to be really sick. He was not relieved by enemata or by catheterization, and he began to vomit. A flat tumor was felt over the symphysis. The stomach was washed but only a few ounces of bile-stained fluid was obtained. The abdomen was distended, soft to palpation, but everywhere tender.

On June 12 the pulse rose to 150, and the patient was in very poor condition. The abdominal pain was extreme, but the abdomen was soft. Repeated enemata failed to bring gas results. There was evidently intestinal obstruction. Operation was decided upon, and under ether a seven-inch median incision was made with the escape of considerable free fluid, disclosing a blackened, distended small bowel. This appeared to be gangrenous ileum due to mesenteric thrombosis. The diseased bowel was removed, leaving a margin of safety of from four to six inches on either side. During the division of the mesentery thrombic plugs were expressed from the mesenteric veins. An end-to-end anastomosis was done.

The patient made a short ether recovery but the pulse remained very rapid and of poor quality. Transfusion was considered, but no donor was available in time. The patient gradually failed and died on June 12, during the afternoon following the operation. No autopsy was allowed.

The blood examination on June 8 showed the hæmoglobin to have risen to 75 per cent. The white cells were 12,000 and the red cells were 4,800,000.

The pathological report upon the spleen on May 29 was as follows:

> Spleen 32 by 13 by 6 cm., smooth surface, section reddish with prominen' trabeculæ. There was an adherent thrombus at the opening of the splenic vein. Microscopical examination showed well marked follicles and vessels with a considerable area of rather hyaline connective tissue about them. The pulp of the spleen showed rather a proliferation of endothelial elements. In some sections the blood capillaries were distinctly enlarged and dilated. Diagnosis: Hypertrophy. (Signed) W. F. Whitney, M.D.

The pathological report upon the intestine removed on June 12 was as follows:

> Portion of the small intestine 3 metres 40 cm. long, which is brownish-black and necrotic. The mesentery is very much thickened, and on section there are numerous veins filled with thrombi. Microscopical examination of sections taken from the mesentery shows the veins widely dilated by a thrombus and the enlarged portion of the mesentery filled with scattered areas of cells and extravasated blood. Diagnosis: Venous thrombosis with infarction. (Signed) H. F. Hartwell, M.D.

Remarks.—I place upon record this case of splenic anæmia which died following splenectomy because it seems to me important to report such cases just at present when the therapeutic value of splenectomy is being discussed and experimental work is being done.

Interest centres in the fact that following a properly conducted splenectomy a thrombosis occurred in a vascular system not directly connected with the vascular system of the spleen. At the second operation the gangrene of the small intestine was found definitely localized and had occurred independently of any plugging thrombosis of the splenic vessels proximal to the ligatures placed at the time of the splenectomy.

THE DIAGNOSIS OF APPENDICITIS IN EARLY TYPHOID FEVER*

By Randolph Winslow, M.D.
of Baltimore, Md.

The appendix vermiformis is a vestigial organ which, like the tongue, "is an unruly evil, full of deadly poison." Its tendencies to evil are shown on so many occasions that it is somewhat noteworthy that it does not exhibit its malevolence in typhoid fever more frequently than appears to be the case. Nevertheless, it is by no means an unimportant factor in the surgical complications of this disease. While appendicitis undoubtedly may coexist with typhoid fever in any and all of its stages, either as a result of the invasion of the lymphoid structures of the appendix by the typhoid bacilli or from the ordinary intestinal and pyogenic organisms, my attention has been directed especially to the question of the diagnosis of appendicitis in the early days of typhoid fever and to the advisability of operating in such cases.

The following case was the occasion of considerable chagrin to me at the time of its occurrence and served to call my attention to this subject.

Case I.—L. F., white female aged eighteen years, while at work on August 9, 1913, was taken suddenly with pain in the right side and headache. Previous to this time she had been in good health. On the tenth she was compelled to take to her bed and so continued until she entered the University Hospital on the thirteenth of the same month. On admission her temperature was 102.6°, pulse 95, respiration 22. She had continuous pain in the right iliac region and tenderness over McBurney's point, with muscular rigidity. She had had nausea and vomiting but no diarrhœa. The tongue was somewhat coated, especially in the middle. The liver and spleen were not palpable. At this time the hæmoglobin was 100, and the leucocyte count 8,200. Widal reaction was not present. The urine showed a slight ring of albumen, a few granular casts and pus cells, sugar and acetone, but no diacetic acid. A diagnosis of appendicitis was made and laparotomy was done, under ether anæsthesia, on August 14. A right rectus incision was made and the appendix removed in the usual manner. This organ was somewhat injected and slightly enlarged, but did not appear to be sufficiently affected to cause her symptoms. The small intestines were reddened and the retroperitoneal glands

* Read before the American Surgical Association, June 9, 1915.

enlarged and I suggested the probability of enteric fever as the cause of her symptoms rather than appendicitis. She subsequently ran a typical typhoid course, the Widal reaction becoming suggestive on the seventeenth and positive on the twentieth. She recovered and was able to leave the hospital in exactly one month from the time of her admission.

Three other cases of similar character were operated on by my colleagues at the University Hospital at about the same time, and they also serve to emphasize the difficulty of diagnosis in these conditions.

Case II.—S. W., white male, twenty years of age, was taken suddenly with chilly sensations, on July 19, 1913. On the next day he again experienced chilliness and had several attacks of vomiting. He developed fever and entered hospital on July 24, five days subsequent to the onset. On admission his temperature was 103°, pulse 90 and respiration 25. He was distinctly ill, with an anxious facies and tongue heavily coated with a whitish-brown fur. No rose spots were present and the spleen was not palpable. There was no evident pain, but the abdomen was rather tender in all areas and deep pressure over the appendical region caused a distinct muscular spasm. On this date his leucocyte count was 10,000 and hæmoglobin 90 per cent. On July 25 his abdomen was opened. The appendix was congested but not acutely inflamed, while a general hyperæmic condition of the intestines was noted. The appendix was removed and the abdomen closed without drainage. The probability of typhoid fever was recognized, and the subsequent course of the case was typical of this disease, including a positive Widal reaction. He died from typhoid toxæmia on August 6, eleven days subsequent to the operation.

Case III.—H. D., white female, aged sixteen years, entered University Hospital on July 6, 1913, complaining of pain in the right side of the abdomen, with rigidity and tenderness on pressure, temperature 102.4°, pulse 122, respiration 22. She was taken sick on July 4 with abdominal pain, headache and a stiff feeling in the abdomen. A diagnosis of acute appendicitis was made and an immediate operation was done. The abdomen was opened under ether anæsthesia, and a slightly inflamed appendix was removed. The cæcum and colon were also congested. A chain of much enlarged lymphatic glands was felt along the right side of the vertebral column. At this time the Widal reaction was negative. She subsequently ran a typical typhoid course and made a good recovery.

Blood examination showed polymorphonuclears 74 per cent., small mononuclears 22 per cent., large mononuclears 4 per cent.

CASE IV.—Miss E., hospital nurse, aged twenty-three years, was taken sick on December 3, 1912, with malaise, pain in back and slight fever. Subsequently the pain localized in the right iliac fossa, with tenderness on pressure, but without much rigidity. Widal was negative at this time and the leucocyte count about 8,000. Acute appendicitis was diagnosticated and laparotomy done on December 12, 1912. The appendix was slightly congested but not materially inflamed, and there was a peculiar cyanosis of the small intestines. There was also considerable glandular enlargement in the mesentery but no free fluid in the peritoneal cavity. The appendix was removed and its mucous membrane was seen to be thickened, with a few superficial ulcerations. She ran a typical typhoid course and recovered in six weeks. Widal reaction was positive in the second week.

We have here four cases occurring in the same hospital at almost the same time and treated by several different surgeons. From the appearance of the appendices at the time of operation, and from the subsequent course of the cases, it is evident that unnecessary operations were done during the active period of a dangerous disease. Was this the result of lack of knowledge on the part of the operators, or of negligence in the examination of the cases; or are the difficulties in establishing a differential diagnosis real and these mistakes excusable?

The cases here reported are too few to draw definite conclusions from, but an analysis of the symptoms may at least be interesting and perhaps suggestive.

Onset of the Disease.—Case I was taken suddenly ill, with headache and pain in the right side, while at work. She had been in good health up to this time. Case II appears to have had a general diffuse tenderness exaggerated on pressure in the appendical area upon admission to the hospital. Apparently the disease began five days previously with chilly sensations followed by fever, and not with pain. Case III was taken sick with abdominal pain, headache and a stiff feeling of the abdomen. There is no history of preceding fever. Case IV was taken with pain and slight elevation of temperature.

In three of these four cases pain appears to have been the symptom that first attracted the patients' attention and not fever.

Chilliness and fever certainly was the prominent feature of the onset of Case II.

In Case I the temperature on admission was 102.6°, four days after the onset, pulse 95.

In Case II temperature was 103°, pulse 90, five days after the onset.

In Case III temperature 102.4°, pulse 122, two days after the onset.

In Case IV temperature was about 100° when the patient took to bed.

Headache was noted in two cases as one of the initial symptoms, and nausea and vomiting in two cases.

The leucocyte count was 8,200, 8,000 and 10,000 in three cases, and in one case the polynuclears were 74 per cent., small mononuclears 22 per cent. and large mononuclears 4 per cent., but the leucocyte count was not recorded.

The hæmoglobin was 100 in Case I, 90 in Case II, and probably not determined in the other cases.

On admission it is specifically stated that Case I had continuous pain in the right iliac region, with tenderness and muscular rigidity at McBurney's point.

In Case II there was diffused abdominal tenderness with distinct muscular spasm on deep pressure over the appendical region.

In Case III there was pain in right side of the abdomen, tenderness but not much muscular rigidity.

In two cases it is recorded that the spleen was not palpable. Diarrhœa was not a prominent symptom in any of these cases.

In none of these cases was the Widal reaction positive at the time of the operation, but became so in each subsequently. Rose spots also do not appear at such an early period of typhoid fever.

In all these cases the appendix was somewhat congested, possibly thickened, but not acutely inflamed, while the large and small intestines were also more hyperæmic than normal.

The mesenteric and prevertebral chains of glands were also markedly enlarged in most of the cases.

I believe this mistaken diagnosis of appendicitis in early typhoid fever is by no means uncommon; and my purpose in presenting this communication is more for the purpose of eliciting information than for imparting it.

I confess that I do not know how we can avoid this mistake. I am aware that Dr. Murphy lays down the rule that in appendicitis pain always precedes fever, while in these atypical typhoid cases fever always precedes pain. I do not think we should accept this statement axiomatically. In many cases it will be impossible to ascertain whether pain or fever was the initial symptom; and in some cases of typhoid fever pain appears to have been the first symptom to attract the patient's attention. Indeed, Osler says enteric fever may be ushered in with pain in the abdomen and that "on account of pain in the right iliac fossa,

fever and constipation the diagnosis of appendicitis has been made and in two such cases at Johns Hopkins Hospital laparotomy was performed." I think it probable that some lesion of the appendix is present in these cases.

The leucocyte count is probably the most reliable diagnostic sign, and it is usually low in typhoid fever and markedly increased in appendicitis, though at times there may be a low leucocyte count in serious and even fatal appendicitis.

I think also there is less muscular rigidity and tenderness in these typhoid cases than in cases of genuine appendicitis. Headache also is more common. Another possible factor in the diagnosis may be the time of the year at which the cases occur, as three of the four cases here reported occurred in July and August, months in which typhoid is especially prevalent.

In conclusion I think it is a very unfortunate occurrence to mistake a case of beginning typhoid fever, with abdominal pain, for appendicitis and to subject such a patient to an abdominal section. This can only be avoided by a careful consideration of the history of the onset of the malady, to ascertain whether fever or pain was the initial symptom; whether the pain was sudden and severe or developed after prodromal symptoms of headache, malaise and fever. If the abdomen is not markedly rigid, even though pain and tenderness in the right iliac fossa be present, and if the leucocyte count remains low, operation should be deferred until a clear diagnosis is reached.

TYPHOID PERFORATION

By John H. Gibbon, M.D.

(Continued from page 408)

Case LXXXIII.—*Perforation. Operation. Death. Autopsy.*

Male, white, laborer, aged twenty-five years; hospital No. 3044; admitted December 29, 1906, on the seventh day of disease. He ran a moderately severe course until the seventeenth day, when he suddenly developed recurrent paroxysms of abdominal pain with chill, abdominal tenderness and rigidity, with flexed legs and thighs, with marked retraction of the abdomen, pinched anxious expression, shock, and elevated pulse and respirations with sudden 4-degree elevation of temperature, and relief to certain extent of symptoms between paroxysms of pain, except abdominal tenderness and slight rigidity. Pulse and respiratory rate remained increased. His Widal was positive on admission with 4600 leucocytes. He was seen by a surgeon 18 hours after the onset of pain. At this time his leucocytes were 8450. Operation 2 hours later, diffuse peritonitis was found with effusion of fecal matter into the cavity. Perforation, 2 mm. in diameter, in the cæcum a few inches above the ileocæcal valve. Perforation was closed, the abdomen drained with gauze, and enteroclysis instituted after operation. Death 12 hours later. Autopsy: No other perforation found but diffuse peritonitis, swelling and deep ulceration of the lymph follicles, swelling of the mesenteric glands and acute splenic tumor.

Case LXXXIV.—*Perforation. Operation. Recovery.*

Male, white, junk dealer, aged twenty-four years; hospital No. 3317; admitted January 23, 1907, on the eleventh day of disease, with a positive Widal and 8900 leucocytes. He ran a mild course from the time of his admission to the seventeenth day of the disease, when he developed sudden sharp recurrent paroxysms of pain with abdominal retraction, with thoracic breathing, lower abdominal rigidity, with tenderness more marked in left lower quadrant, and a 6-degree elevation of temperature from normal, with 25 per cent. increase in respiratory rate and 30 per cent. increase in pulse rate over the highest recorded for the same day. Two minutes' auscultation did not reveal any peristaltic sounds. No change in liver dulness. Leucocyte count 3 hours before operation 6600. Marked tenderness on rectal examination. Operation, ethyl-chloride-ether anæsthesia, 5 hours

after onset of pain, some soiling of peritoneal cavity with perforation in ileum, location not stated, and pin-head in size. Perforation sutured, abdomen flushed with salt solution, gauze drainage, uneventful recovery.

CASE LXXXV.—*Perforation. Operation. Death. Autopsy.*

Male, white, fireman, aged twenty-seven years; hospital No. 3424; admitted February 1, 1907, on the sixteenth day of the disease, with a suggestive Widal, 2900 leucocytes, and a severe infection. On the eighteenth day he developed recurrent paroxysms of abdominal pain (slept for 15 minutes between paroxysms), had a chill, was nauseated, his pulse jumped from 100 to 120 without change in respiratory rate, his temperature was elevated 3 degrees over previous temperature, marked abdominal tenderness over lower quadrants, slight rigidity over the right lower quadrant, decreased liver dulness, audible abdominal breath sounds, no peristaltic sounds heard, leucocyte count 4 hours after onset of pain 3100, 5 hours after, 5500, 8 hours after, 6900. Operation, 10 hours after onset of pain, small perforation (pin-head in size) found in ileum 18 inches above the ileocæcal valve. Perforation closed, abdomen irrigated, gauze and rubber tube drainage, Murphy treatment instituted. Death two days after operation. Autopsy: General peritonitis, no other perforation.

CASE LXXXVI.—*Perforation (on admission). Operation. Recovery.*

Male, white, tailor, aged thirty-eight years; hospital No. 3527; admitted February 11, 1907. Patient had been sick for three weeks with symptoms of typhoid fever. There was no record of leucocytes or Widal in this case. On the day before admission he had taken a large dose of cascara. Seven hours before admission to the hospital he was seized with sudden severe abdominal pain and had a chill. He was referred to the hospital as a case of acute appendicitis. On admission he had marked generalized abdominal pain with considerable distention, tenderness and rigidity. No peristaltic sounds were heard, but the breath sounds were audible over the entire abdomen, liver dulness was absent to the mid-axillary line, and rectal examination revealed marked tenderness. His temperature on admission was 102°, respirations 28, and his pulse 106. Judging from the patient's history the previous course of his typhoid had not been severe. Diagnosis of typhoid perforation was made and operation done soon after. General peritonitis with a perforation in the ileum 3 mm. in diameter and 3 inches above the ileocæcal valve which was sutured, abdomen irrigated, and drained with gauze. Enteroclysis given after operation. Recovered and was discharged from the hospital April 4, 1907.

CASE LXXXVII.—*Perforation. Operation. Death. Autopsy.*

Male, teamster, aged forty years; hospital No. 3563; admitted February 14, 1907, with a severe infection, on the twelfth day of disease, with a positive Widal and 7200 leucocytes. On the twenty-first day he had a severe chill with moderate abdominal pain after the chill, his pulse jumped from 92 to 140, slight abdominal tenderness, and slight rigidity of the right rectus. His abdominal distention, which he had had since his admission, became increased and his temperature rather high, but remitting. Immediately after the chill he had a 5-degree elevation of temperature. His liver dulness was impaired, but not obliterated, and his respiratory rate increased. At this time he was seen by the attending physician and a surgeon, and the diagnosis of perforation was in doubt. Owing to his extremely bad condition and an existing bronchopneumonia, operation was deferred. His leucocyte count at the onset of pain was 4400, 8 hours later, 7200, and 21 hours later, 8600. Operation under ethyl-chloride-ether anæsthesia 21 hours after onset of pain. General peritonitis was found with a perforation, pin-head in size, in ileum 12 inches above the ileocæcal valve. It was sutured and the abdomen drained. Patient's condition became worse and he died 15 hours after operation. Autopsy showed general peritonitis and another perforation one foot above the one found at the time of operation.

CASE LXXXVIII.—*Perforation. Operation. Recovery.*

Female, white, housework, aged thirty-seven years; hospital No. 167; admitted April 4, 1907, on the tenth day of a marked infection, with a positive Widal and 6750 leucocytes. On the thirteenth day abdomen became distended, with slight abdominal pain, and remained so until the seventeenth day, when she complained of sudden severe abdominal pain in the right lower quadrant with marked tenderness and rigidity of the right rectus. This was accompanied by vomiting. The pulse rate increased 20 per cent. over the highest previous count for the same day, respirations were increased, and there was an immediate drop of temperature (2½ degrees) at the onset of pain with a subsequent elevation of 4 degrees. The leucocyte count just before operation was 14,500. Operation, ethyl-chloride-ether anæsthesia, 5 hours after onset of severe pain, right rectus incision, perforation found, pin-head in size, in the cæcum near the base of the appendix. It was closed and the abdomen drained with gauze. After the operation she continued a mild febrile course for 22 days but made an uneventful recovery and was discharged cured 52 days after operation.

CASE LXXXIX.—*Perforation (on admission). Operation. Death. Autopsy.*

Male, white, aged thirty years; hospital No. 4336; admitted April 22, 1907. This patient had been sick for about 17 days before admission to the hospital. He seemed to be suffering from a severe infection and there is no record of Widal or leucocyte count in this case. Two days before admission he was seized with severe abdominal pain and vomiting, which had been worse during the 24 hours previous to admission. Was very constipated. Pain began in the right iliac fossa and then became generalized. Had diarrhœa for several days before admission with one intestinal hemorrhage. The liver dulness was obliterated and he presented the picture of diffuse peritonitis. At operation, soon after admission, general peritonitis was found with a perforation 3 mm. in diameter in the ileum 3 inches above the ileocæcal valve. It was sutured, the abdomen irrigated with salt solution, and drained with gauze. He died 5 hours after operation. Autopsy showed general peritonitis, no other perforation, bronchopneumonia and pulmonary tuberculosis.

CASE XC.—*Perforation. Operation. Death.*

Male, white, engineer, aged thirty-three years; hospital No. 785; admitted June 17, 1907, on about the seventh day of a severe typhoid with pronounced toxæmia, Widal and admission leucocytes not recorded. About the sixteenth day of the infection he had a severe chill with marked abdominal pain and great tenderness and rigidity over the lower half of the abdomen. His liver dulness was obliterated and he had a severe hemorrhage just before the onset of pain. He also complained of vesical and rectal pressure pain. He was operated upon a few hours later and a large perforation found in the ileum, near the cæcum, with general peritonitis. The perforation was sutured, the abdomen drained with gauze after irrigation, and death 36 hours after operation, probably from peritonitis. No autopsy. (The temperature, pulse, and respiratory changes in this case were not given because the temperature chart had been lost.)

CASE XCI.—*Perforation. Operation. Recovery.*

Male, white, laborer, aged thirty-three years; hospital No. 1741; admitted September 16, 1907, on the eleventh day of the disease, with a moderately severe infection, Widal negative, and leucocytes 9100. At the time of admission he complained of slight pain and tenderness in the right iliac fossa and his abdomen was distended. On the twelfth day of disease he developed sudden severe cramp-like pain in the right lower quadrant of the abdomen, had two or three paroxysms at ten- or fifteen-minute intervals, abdomen became very tender and rigid, had a chill, pulse was increased from 100 to 124, and there was a 4-degree temperature elevation. His leucocytes at the onset of pain were 9250, one hour

later 8900. Operation two hours after onset of pain, ethyl-chloride-ether anæsthesia, right rectus incision. Much fecal matter and fluid found in peritoneal cavity with two perforations, one in ileum (location not stated), one-fourth of an inch in diameter, and the other in the cæcum "half the size of a penny." Both closed with linen thread suture, abdomen flushed with salt solution, and drained with gauze. Murphy treatment instituted. Temperature practically normal on tenth day after operation, except for an occasional slight rise afterwards. Developed fecal fistula fourth day after operation which persisted, but in spite of this he continued to gain weight and was discharged on the fiftieth day after operation with a small fistula, which required dressing once in 24 hours.

CASE XCII.—*Perforation. Operation. Recovery.*

Male, white, tailor, aged twenty years; hospital No. 2154; admitted October 24, 1907. Was admitted with a history of having been sick for four days with general malaise, headache, and "ill feeling." On admission he had a positive Widal, 13,350 leucocytes, and was considered a case of ambulatory typhoid fever. On admission his pulse was 108, respirations 32, temperature 101°, and he had been in bed only three days. When he came to the hospital he complained of having had severe pain in his abdomen for three days. He had considerable distention, generalized rigidity with marked tenderness in the left lower quadrant. Operation 16 hours after admission, ethyl-chloride-ether anæsthesia, right rectus incision. On opening the peritoneum gas and much free purulent fluid with fecal odor escaped. Small perforation found in ileum, location not stated, which was closed, the abdomen was irrigated, and the wound closed without drainage. Temperature was normal the third day after operation; he had slight fever from the seventh to the tenth day after the operation, when it was discovered that he had a slight wound infection. After this he made an uneventful recovery and was discharged the fifty-first day.

CASE XCIII.—*Perforation. Operation. Death. Autopsy.*

Female, white, saleslady, aged seventeen years; hospital No. 2281; admitted November 5, 1907, on the eighth day of a severe infection, with a very suggestive Widal and 4150 leucocytes. Abdomen was distended from the time of admission and she had several profuse hemorrhages, both before and after her admission, with slight diarrhœa. On the sixteenth day of disease she had a chill with sudden sharp, cramp-like umbilical pain, abating after the insertion of a rectal tube. Marked abdominal tenderness with generalized rigidity. She lay on her side with legs and thighs flexed, with rectal tenesmus, with moderate distention, and with

marked pain on palpation. Pulse previous to onset of pain was 108, it jumped to 140, respirations were increased 40 per cent., with a sharp 3-degree temperature elevation. Leucocytes at the onset of pain were 7800, two hours later, and a half hour before operation, 4400. Operation, ethyl-chloride-ether anæsthesia, right rectus incision, considerable turbid fluid in the abdomen with plastic exudate about the site of perforation which was found in the ileum, 14 inches above the ileocæcal valve, size not stated. Two other deep ulcers were invaginated. The abdomen was drained with gauze. On the fourth day after operation she developed a right-sided pneumonia; on the tenth day it became bilateral; and she died on the eleventh day after operation. The abdominal condition up to this time had been satisfactory. Autopsy showed double lobar pneumonia, cloudy swelling of the heart and liver, slight plastic peritonitis about the site of perforation, and no secondary perforation.

CASE XCIV.—*Perforation. Death. Autopsy.*

Male, white, miller, aged thirty-seven years; hospital No. 2734; admitted December 20, 1907, on the fifteenth day of a severe infection, with a positive Widal and 8350 leucocytes. Patient was very sick and stupid from the time of his admission, abdomen considerably distended. On the eighteenth day had a chill, abdomen became more distended, legs and thighs flexed, there was slight generalized tenderness on palpation, the abdomen was slightly resistent, and there was dulness on percussion in the right flank. After the chill he had a 6-degree temperature elevation, his pulse became so rapid and weak that it could not be counted, respirations jumped from 22 to 40, and he seemed in a state of extreme shock. He reacted very poorly to stimulation and subsequently collapsed and died 18 hours after chill, on the nineteenth day of disease. Autopsy showed general peritonitis with a perforation, 1.5 cm. in diameter, in the ileum 50 cm. from the ileocæcal valve, acute bronchopneumonia with a stricture of the ureters and a double hydronephrosis.

CASE XCV.—*Perforation. Operation. Death.*

Male, white, laborer, aged forty-five years; hospital No. 3201; admitted February 2, 1908, on the eighth day of a severe infection, with a positive Widal and 9650 leucocytes. After his admission he had slight diarrhœa with slight abdominal distention up to the twenty-ninth day, with moderately high fever (103 to 104). On the twenty-ninth and thirtieth days he had 3 distinct attacks of cramp-like abdominal pain. The first attack was subsequent to a 13-ounce hemorrhage, after which he was given heavy doses of opium. Fifteen hours later he had a second attack of pain with increasing distention, moderate generalized tenderness, with seem-

ing slight improvement in condition and abdominal signs between attacks of abdominal pain. Twenty-four hours after the first attack of pain he had the third attack which was severe, pain more marked in the left lower quadrant with increasing tenderness, diminished peristalsis, and obliterated liver dulness. His pulse immediately became much accelerated after the first attack of pain, a 30 per cent. increase over the highest previous count, with a proportionate respiratory increase. With the first attack of pain there was an immediate drop in temperature with a subsequent rise, after which it became slightly fluctuating. His leucocyte count was 10,250, 24 hours after onset of pain. The circulatory and respiratory disturbance in this case seemed out of proportion to the local abdominal signs and symptoms. Operation 30 hours after onset of pain under ethyl-chloride-ether anæsthesia. On opening the peritoneum it was found filled with purulent fluid and blood, with 3 perforations in the ileum 24 to 36 inches from the ileocæcal valve, varying in size from that of a dime to a quarter of a dollar. This loop of intestine was brought into the wound, surrounded with gauze, and a fistula made. The shock of the operation was severe. Death 12 hours after operation without good reaction.

CASE XCVI.—*Perforation. Operation. Death.*

Male, white, laborer, aged thirty years; hospital No. 3336; admitted February 14, 1908, on the fourteenth day of a moderate infection, positive Widal, and 2350 leucocytes. After his admission he had slight diarrhœa with abdominal distention. On the twenty-first day he complained of slight abdominal pain which persisted for 12 hours, when he had a severe attack of abdominal pain with accelerated pulse and respirations. His temperature immediately dropped 2 degrees with a subsequent 4-degree elevation. With the onset of the slight abdominal pain he also had slight persistent tenderness and increasing distention, and with the onset of the severe pain he had marked tenderness and rigidity, which was more pronounced in the left lower quadrant; peristalsis was diminished, liver dulness partially obliterated, and his leucocytes two hours before operation were 4700. Operation, ethyl-chloride-ether anæsthesia, two hours after onset of severe pain. A small perforation was found in the ileum 24 inches above the ileocæcal valve—it was sutured, the abdomen drained with gauze, and Murphy treatment instituted. Did well for 2 days, when he developed lobar pneumonia and died the third day after operation.

CASE XCVII.—*Perforation. Operation. Recovery.*

Male, white, street cleaner, aged nineteen years; hospital No. 135; admitted February 14, 1908, on the sixteenth day of a severe infection, with a positive Widal and 4800 leucocytes. The symp-

toms in this case on which the diagnosis of perforation was based were not recorded. Perforation occurred on the twenty-first day, operation soon after onset of perforative symptoms, ethyl-chloride-ether anæsthesia, right rectus incision. Free purulent fluid found on opening the peritoneum, with plastic peritonitis about the cæcum and coil of intestine containing perforation, which was about the size of a lead pencil, and in the ileum 18 inches above the ileocæcal valve. It was sutured, the abdomen irrigated, and drained with gauze. Murphy treatment instituted. Stood the operation fairly well and on the seventh day the gauze drain was removed and a profuse fecal discharge followed. The patient continued to do well. The fecal fistula persisted for three months, when it closed and he was discharged cured. Other than this his recovery was uneventful.

CASE XCVIII.—*Perforation. Operation. Death.*

Male, white, laborer, aged twenty-six years; hospital No. 3380; admitted February 17, 1908, on the seventh day of a mild infection, with a positive Widal and 5250 leucocytes. On the twentieth day he complained of slight abdominal pain, increasing abdominal distention, with a slight tenderness in the left half of the abdomen, which persisted for 6 hours, when he had an attack of severe pain, sudden in onset, with accelerated pulse and respirations, nausea, lessened peristalsis, diminished liver dulness, and increasing abdominal tenderness and rigidity. His leucocyte count 12 hours before operation was 5550. Operation, ethyl-chloride-ether anæsthesia, perforation found, pin-head in size, in the ileum 4 cm. above the ileocæcal valve. It was closed and the abdomen drained with gauze. Death at the end of the third day. Autopsy: Diffuse peritonitis, no secondary perforation.

CASE XCIX.—*Perforation. Death. Autopsy.*

Male, white, laborer, aged thirty-five years; hospital No. 3905; admitted March 30, 1908, on the sixth (?) day of a severe infection, with a negative Widal and 11,700 leucocytes. This patient, a well-developed Italian, complained of being sick for 6 days before admission with cough, chill, expectoration, pain in the chest, and vomiting. His temperature on admission was 104°, pulse 120, respirations 36. The abdomen was full, soft, and not tender. On the seventh day (day after admission) he developed signs of pneumonia at the left base. The abdomen remained full and soft and the spleen not palpable. At 11 P.M. on the seventh day he was visited by the resident physician, who found him with Cheyne-Stokes breathing, the dyspnœic periods lasting about ten seconds, with four or five shallow respirations, and the apnœic periods were about 15 seconds on the average. The pulse ranged from 124 to 146, respirations from 28 to 40, and there was marked cyanosis

of the face and hands. A phlebotomy was done and 15 ounces of blood taken, after which 21 ounces of normal salt solution were given intravenously, which seemed to relieve him. The respirations became regular, cyanosis cleared up, and the pulse improved. Soon after this the abdomen became greatly distended with partial obliteration of liver dulness and great restlessness. On the morning of the eighth day he sat up in bed, suddenly dropped over, and died, vomiting at this time. His pulse had become more irregular after 2 A.M. and he voided 27 ounces of urine in the previous 35 hours, which contained much albumen and many granular casts. Autopsy showed hemorrhagic infiltration of intestines with typhoid ulceration of the ileum and with a perforation 2 mm. in diameter in the ileum 18 cm. above the ileocæcal valve. Multiple thrombosis of the portal vein, fibrinopurulent pleurisy with effusion, obliterative pericarditis, chronic diffused nephritis, cloudy swelling of the liver, bronchopneumonia, and peritonitis.

CASE C.—*Perforation. Death. Autopsy.*

Male, white, brick-layer, aged forty-five years; hospital No. 3906; admitted March 30, 1908, with prodromal symptoms extending over an indefinite period of a few weeks. Three days prior to his admission he developed acute abdominal pain with distention and tenderness. Before this his chief complaint had been cough, without expectoration, labored breathing, and profuse sweating. On admission he seemed very ill, pulse was 120, respirations were 60, his temperature was 102, and he had marked abdominal distention. He was seen by a surgeon who thought he had a pyopneumothorax and advised thoracic aspiration, which was done and 200 c.c. of pus withdrawn. The abdomen at this time was tense, rigid, and distended. The left chest was clear throughout. A few hours later he began to vomit, became rapidly worse, and died 18 hours after admission. Autopsy showed general fibrinopurulent peritonitis, ulceration of the ileum with perforation 2 cm. in diameter 100 cm. above the ileocæcal valve, cloudy swelling of the liver and kidneys, acute splenic tumor, acute pleurisy with purulent effusion, acute bronchopneumonia.

CASE CI.—*Perforation. Operation. Death. Autopsy.*

Male, white, student, aged fourteen years; hospital No. 149; admitted April 6, 1908, with a positive Widal, 3950 leucocytes, and on the fifteenth day of moderate infection. The disease was uncomplicated up to the twenty-eighth day, when he developed recurring attacks of sharp abdominal pain, which at first were localized to the right lower quadrant, but later seemed almost as severe in the left lower quadrant. With the onset of pain he had a severe chill with a 4-degree elevation of temperature, 30 per cent. increase in pulse rate, 40 per cent. increase in respiratory

rate, increasing abdominal tenderness and rigidity, diminished peristalsis without much apparent change in liver dulness, abdomen distended with rapidly increasing signs of peritonitis. His leucocytes one week before the onset of pain were 5500, two hours after the onset of pain, 5700, 9 hours after the onset of pain, 2650. During this time the patient's condition was becoming more grave. Operation 12 hours after onset of pain, ethyl-chloride-ether anæsthesia, right rectus incision. The abdomen was filled with yellow turbid fluid with adhesions between the coils of intestine and much lymph. There was a free escape of pus between the coils of intestine and mesentery about the cæcum. No perforation was found. No evident rupture of the mesentery gland. The abdomen was drained with gauze. Patient died 9 days later. A partial autopsy was done, several small perforations were found in the cæcum with extensive ulceration of the ileum and cæcum.

CASE CII.—*Perforation. Operation. Recovery.*

Male, white, student, aged ten years; hospital No. 150; admitted April 4, 1908, on the twenty-second day of a moderate infection, with a positive Widal and 6600 leucocytes. He continued a moderate febrile course until the thirty-third day, when he was seized with sharp abdominal pain in the left lower quadrant (recurring attacks), with a severe chill, marked acceleration of pulse and respirations with great tenderness over the left lower quadrant, increasing muscular rigidity, and considerable abdominal distention. There was almost entire relief from pain and tenderness between sharp attacks. Sharp elevation of temperature and liver dulness not obliterated. Leucocytes 6 hours after the onset of pain were 5750, 10 hours after, 4900. At this time the abdomen was opened, ethyl-chloride-ether anæsthesia, through a right rectus incision. Opening the peritoneum there was a free escape of turbid fluid, the intestines were covered with plastic lymph, and a pin-head perforation was found in the ileum 12 inches above the ileocæcal valve. It was closed with silk sutures and another deep pre-perforative ulcer was invaginated. Gauze drainage instituted. Fever continued 8 days after operation with a subsequent 10-day relapse, beginning on the twentieth day after operation. He made an uneventful recovery after this and was discharged cured on the ninetieth day after operation.

CASE CIII.—*Perforation. Death. Autopsy.*

Male, white, laborer, aged forty years; hospital No. 4014; admitted April 8, 1908, on the ninth day of a severe infection, with a positive Widal and a positive blood culture for typhoid bacilli and a leucocyte count of 4550. Patient was very sick and profoundly toxic with slight diarrhœa and considerable abdominal

distention from the time of his admission. On the nineteenth day he developed signs of pneumonia, on the twenty-first day he had a chill, accelerated pulse and respirations, a 3-degree temperature elevation, but did not complain of pain or tenderness on interrogation. At this time he was profoundly toxic and almost stuporous, his abdomen becoming more distended, soon became delirious, and died on the twenty-third day without complaining of any abdominal discomfort at any time. Autopsy showed bronchopneumonia, cloudy swelling of heart, liver, and kidneys, general peritonitis, and typhoid ulceration of the ileum with a pin-head perforation in the ileum, 7 cm. above the ileocæcal valve.

CASE CIV.—*Perforation. Operation. Death.*

Male, white, laborer, aged thirty-three years; hospital No. 683; admitted June 5, 1908, on the tenth day of a severe typhoid, with a negative Widal and 7000 leucocytes. On the twenty-second day suddenly seized with severe pain, stitch-like in character, about the umbilicus. His pulse and respirations were very much accelerated, his pulse becoming so weak that an accurate count could not be made. Twelve hours later he had another severe attack of pain, again producing circulatory collapse with generalized tenderness and rigidity and increasing signs of peritonitis. His leucocytes at the onset of pain were 3750, 24 hours later, 4850. A day or so previous to the onset of his abdominal symptoms he had diarrhœa with one profuse intestinal hemorrhage. His temperature after the first attack of abdominal pain became remitting in character. Operation, which had been advised early, was refused until 30 hours after the onset of pain. Under ethyl-chloride-ether anæsthesia the abdomen was opened through a right rectus incision, general peritonitis was found with two perforations about a half an inch apart, one-eighth of an inch in diameter, in the ileum 7 inches above the ileocæcal valve. They were invaginated, the abdomen irrigated and drained with gauze. Died 12 hours later. No autopsy.

CASE CV.—*Perforation. Operation. Recovery.*

Male, white, painter, aged eighteen years; hospital No. 1285; admitted July 27, 1908, on the ninth day of a severe infection, with a very suggestive Widal and 5450 leucocytes. He had slight diarrhœa with considerable toxæmia. On the sixteenth day he developed sudden severe, cramp-like pain in the right lower quadrant with marked acceleration of the pulse and respirations, pulse 80 to 120 and very weak, respirations 24 to 40 with cyanosis and with tenderness and rigidity of the lower abdomen, most marked in the right iliac fossa. At the onset of pain his temperature dropped to normal, with a sharp 6-degree rise 3 hours later. Operation was done 3 hours after the onset of pain, abdo-

men opened under local anæsthesia and the operation concluded under ether anæsthesia. There was considerable soiling of the peritoneum and a " shot-like " perforation was found in the ileum 6 inches above the ileocæcal valve. It was closed, the abdomen was irrigated, and drained with gauze. During the next day he had 5 intestinal hemorrhages and developed a parotitis, but the abdominal condition continued satisfactorily. The temperature had gradually reached normal on the twenty-first day after operation, the wound had healed five weeks after operation, and he was discharged cured.

CASE CVI.—*Perforation. Operation. Death. Autopsy.*

Female, white, housework, aged forty-eight years; hospital No. 1717; admitted September 6, 1908, on the seventh day of a severe typhoid, positive Widal, and 7200 leucocytes. On the ninth day she complained of slight abdominal pain for 3 days; with this she had slight tenderness and a little muscular rigidity but there was no perceptible change in her general condition. On the twelfth day the pain suddenly became very severe, she had a chill, marked acceleration of the pulse which became almost imperceptible, vomited once, and had marked tenderness and rigidity in the left lower quadrant, which soon became generalized. There was much shock, and her temperature at the onset of these symptoms dropped 2 degrees with a quick subsequent 3½-degree elevation. Leucocytes two hours before operation were 7000. Operation was done 4 hours after the onset of symptoms. There was considerable soiling of the peritoneal cavity and a perforation an eighth of an inch in diameter was found in the ileum 15 inches from the ileocæcal valve. The abdomen was irrigated, gauze drainage established. Patient did well for two days, condition greatly improving, and there was no abdominal distention or tenderness. On the third day after operation complained of abdominal pain, and the abdomen was distended. On the fourth day after operation she had 3 intestinal hemorrhages totalling 26 ounces, and died soon afterwards. A partial autopsy was done, the original perforating ulcer had sloughed and there was another perforation near this. There was diffuse peritonitis and the abdominal cavity was filled with blood and intestinal contents.

CASE CVII.—*Perforation. Operation. Death. Autopsy.*

Male, colored, coal heaver, aged twenty-three years; hospital No. 2025; admitted October 4, 1908, on the twenty-first day of a moderate infection, with a negative Widal and 6200 leucocytes. The patient had diarrhœa and slight abdominal distention from the time of admission. On the thirtieth day he developed slowly increasing abdominal pain with remissions in its severity from time to time, but each recurring attack being more severe. With

this was considerable tenderness in the right lower quadrant with rigidity of the right lower rectus. Owing to the frequent attacks and colicky character of his pain without any marked change in his general condition for the first two days, it was thought that he had an appendicitis. At the end of 48 hours he had vomited once and at this time his rigidity and tenderness had become more diffuse and he had persistent hiccough. During the first 24 hours operation had been advised for appendicitis, but had been refused. His pulse after the first 24 hours became accelerated and he had a slight chill. At the onset of pain he had 9400 leucocytes, and just before operation he had 21,000. He was operated upon 52 hours after the onset of pain. A general purulent peritonitis was found with a perforation 8 mm. in diameter in the ileum 18 cm. from the ileocæcal valve. It was closed, the abdomen was irrigated and drained with gauze. Enteroclysis with the patient on the right side and head of the bed elevated. Death 12 hours later. Autopsy: Bronchopneumonia, general purulent peritonitis with two other perforations, one 7 mm. in diameter in the ileum 40 cm. above the ileocæcal valve and another pin-point in size 1 cm. above the ileocæcal valve.

CASE CVIII.—*Perforation. Operation. Recovery.*

Male, white, barber, aged twenty-eight years; hospital No. 2100; admitted October 11, 1908, on the twelfth day of a mild infection, with a suggestive Widal and 4650 leucocytes. On the fourteenth day he had a severe attack of pain in left lower abdomen, he vomited once after taking milk just previous to the onset of pain, there was no rigidity, but moderate persisting tenderness in the left lower quadrant. There was slight distention of the abdomen but no noticeable change in his general condition. Peristalsis was diminished and there were audible abdominal breath sounds. Liver dulness was obliterated to the anterior axillary line. Leucocytes 6300 just before operation, which was done under ethyl-chloride-ether anæsthesia 12 hours after the onset of pain. There was marked effusion of fluid and intestinal contents in the peritoneal cavity with diffuse plastic peritonitis. A pinhead perforation was found at the ileocæcal juncture and another one-sixteenth of an inch in diameter in the ileum 2½ feet above the ileocæcal valve. Both were closed with purse-string sutures. The abdomen was irrigated and the wound closed without drainage. Murphy treatment instituted. Fever continued after operation and on the eighth day the wound was dressed and found infected. There was also a bulging mass at the right costal margin. This seemed to communicate with the upper end of the incision and on opening it considerable fecal matter escaped, a fecal fistula discharged freely for several days and the temperature dropped to

normal. Subsequent to this he developed a large pelvic abscess which was opened and drained through the rectum. He was discharged 38 days after the operation cured.

CASE CIX.—*Perforation. Operation. Death. Autopsy.*

Male, white, farmer, aged nineteen years; hospital No. 3085; admitted January 4, 1909, on the twenty-first day of an ambulatory typhoid, with a positive Widal and 8900 leucocytes. On admission temperature was 103°, pulse 108, respirations 28. Thirty-six hours before admission he had acute sudden abdominal pain and vomiting. After entering the hospital he complained of abdominal pain and tenderness, both recti were rigid, he vomited several times, and movable dulness was noted in his flank. Twenty-four hours later his abdomen was opened under local anæsthesia and a diffuse suppurative and plastic peritonitis found, the appendix and cæcum being adherent. A 5 mm. perforation was found 4 inches above the ileocæcal valve, the appendix was acutely inflamed and was removed. The perforation was not closed but brought into the wound and surrounded with gauze packs. The abdomen was irrigated and drained. Patient died 30 hours after operation. Autopsy revealed diffuse peritonitis without any other perforation.

CASE CX.—*Perforation. Operation. Death.*

Male, white, business man, aged sixty-one years; hospital No. 3875; admitted March 8, 1909, probably in the third week of the disease. In the first part of his illness had an obstinate constipation but later a very foul and offensive diarrhœa. On or about the twenty-first day of his illness he was awakened with sharp abdominal pains which disappeared rather quickly. Two and a half hours later he had another violent attack of pain, but within an hour was perfectly comfortable. Temperature had dropped from a 101° to normal and his pulse at this time was 96. He had voided urine and had had a slight bowel movement after the onset of pain. He had no marked rigidity but was distinctly tender over the right lower quadrant. His leucocytes were 8400. Four hours later the tenderness was much less marked and, owing to his comfortable and good condition (no opiate having been given), the attending surgeon thought it advisable to defer operation, feeling that perforation had not occurred. Four hours later his tenderness had increased but the patient was quite comfortable and lying on his side. Operation at that time was urged, but he was not operated upon until 5 hours later, or 18 hours after the onset of his first pain. Under morphia-chloride of ethyl anæsthesia the abdomen was opened through the right rectus muscle; there was an escape of brownish fluid, a small perforation was found 3 inches from the cæcum which was closed with catgut and

linen thread suture. Another ulcer threatening perforation was also inverted. The appendix was normal and no other perforation was found. The pelvis and kidney pouch were drained with gauze, patient placed in the Fowler position and Murphy treatment instituted. The patient died 5 days later, probably from toxæmia, without further signs of peritonitis. No autopsy.

CASE CXI.—*Perforation. Death. Autopsy.*

Male, white, waiter, aged thirty-four years; hospital No. 3957; admitted March 16, 1909, on the ninth day of a very severe illness, with a positive Widal, 17,300 leucocytes and his blood culture showing a pure growth of typhoid bacillus. This patient was profoundly toxic and delirious from the time of admission, his abdomen was distended and he had diarrhœa, temperature was high, his pulse was 120 or more from the time of his admission. On the sixteenth day he vomited a large quantity of brown liquid, suddenly collapsed and died shortly afterwards. Autopsy: Peritonitis, cloudy swelling of heart, liver and kidneys, acute splenic tumor, congestion of the lungs, typhoid ulceration of the ileum with pin-point perforation in the ileum, near the ileocæcal valve. Perforation in this case was not diagnosed and probably not suspected.

CASE CXII.—*Perforation. Operation. Death. Autopsy.*

Male, white, conductor, aged twenty-two years; hospital No. 480; admitted May 13, 1909, on the sixth day of a severe infection, with a positive Widal and 5900 leucocytes. He suffered abdominal distention and marked diarrhœa from the time of his admission. On the nineteenth day he complained of abdominal pain, considerable tenderness and rigidity with a great deal of abdominal distention, and obliteration of the liver dulness. At the end of 12 hours he then developed very sudden and very severe pain with marked acceleration of the pulse, shock, and circulatory collapse with increased tenderness and rigidity of the abdomen. Operation, ethyl-chloride-ether anæsthesia, 14 hours after the onset of the first pain. On opening the peritoneum there was much purulent fluid with lymph over the intestines. A perforation 1.5 mm. in diameter was found in the ileum 8 inches above the ileocæcal valve. This was closed, another deep ulcer invaginated, the abdominal cavity irrigated and drained with gauze. Death 2 hours later. Autopsy: General peritonitis, bronchopneumonia, chronic pulmonary tuberculosis, and another perforation, pin-head in size, in the ileum near the ileocæcal valve.

CASE CXIII.—*Perforation. Operation. Death.*

Male, white, laborer, aged thirty-eight years; hospital No. 1623; admitted August 30, 1909, on the fifteenth day of an ambulatory typhoid, positive Widal and 10,100 leucocytes. This patient

had been sick for two weeks with malaise and headache, but did not consider himself very sick until 30 hours before admission, when he suddenly developed acute abdominal pain with a great deal of "soreness." On admission the patient was in very poor condition, pulse was rapid, weak, and of poor quality, he was cyanotic, his abdomen was distended with generalized tenderness and rigidity, and he presented the usual picture of a diffuse peritonitis. Operation was done soon after admission under ethyl-chloride-ether anæsthesia. On opening the peritoneum a general peritonitis was found with effusion of the intestinal contents into the peritoneal cavity and two perforations, one was "small" and found in the ileum near the ileojejunal juncture; the other was as large as the tip of a finger and was in the last portion of the jejunum. This portion of the intestine was brought into the wound, surrounded with gauze, and a fistula operation done after the method employed by Hays. The wound was drained with gauze and he did well for 3 days after operation, when he had another severe attack of abdominal pain with collapse and death in a few hours. It was thought that he had another perforation but no autopsy was done.

CASE CXIV.—*Perforation. Operation. Death.*

Male, white, student, aged eleven years; hospital No. 3147; admitted January 14, 1910, on the tenth day of a severe infection, with a positive Widal and 6950 leucocytes. This patient had 9 small hemorrhages from the tenth to the thirteenth days and during this time he was kept deeply under the influence of opium. On the twelfth day considerable abdominal tenderness and rigidity were noted, but without complaint of pain. Up to that day his pulse had not been recorded above 108, which was just after a 6-ounce hemorrhage. Later in the day he had another 6-ounce hemorrhage and his pulse increased to 144 with increased abdominal tenderness and rigidity and gradual failure in his general condition. Leucocytes, 4900. Operation under ethyl-chloride-ether anæsthesia on the third day after the onset of tenderness and rigidity, 5 perforations were found, all leaking fecal material, and within the last 6 or 7 inches of the ileum. The largest was 1.5 cm. in diameter, the others were smaller. This section of the bowel was brought into the wound, surrounded with gauze, and the perforations were not closed. Death 3 days later. It was thought that death occurred from toxæmia, but no autopsy was done.

CASE CXV.—*Perforation. Death. Autopsy.*

Female, white, coat-maker, aged thirty-five years; hospital No. 3701; admitted February 28, 1910, on the ninth day of a moderately severe infection, with a positive Widal and 8650 leucocytes.

This patient had reached the sixteenth day without complications, her temperature had gradually fallen, and it looked as if she was nearing convalescence, when she had a severe chill with a rapid rise in pulse rate, 102 to 130, respirations 28 to 42, and a 4-degree elevation of temperature with acute sudden abdominal pain, more marked in the right iliac fossa, with tenderness and rigidity. She vomited twice, peristalsis was diminished and her leucocytes after the onset of pain were 7650, and there was also evidence of free fluid in the abdominal cavity. On the following day pain, tenderness and rigidity had increased, pulse was rapid and weak, frequent vomiting occurred and death took place rather suddenly 48 hours after the onset of pain. Autopsy: Acute general purulent peritonitis with a 7 mm. perforation in the ileum 4 cm. above the ileocæcal valve with marked ulceration of the ileum.

CASE CXVI.—*Perforation. Death. Autopsy.*

Female, colored, cook, aged forty-four years; hospital No. 778; admitted June 7, 1910, on the ninth day of a violent typhoid, positive Widal, and 4000 leucocytes with moderate distention of the abdomen. Soon after her admission she had an 11-ounce hemorrhage, with a 12-ounce hemorrhage on the following day. On the eleventh day she complained of abdominal pain, the severity not stated. At this time there was slight tenderness, distention, and some rigidity of the abdomen. Her leucocytes were 6500 and the differential count showed 70 per cent. polymorphonuclears, 20 per cent. small lymphocytes, 1 per cent. large lymphocytes, 3 per cent. mononuclears, and 6 per cent. transitionals. On the twelfth day the pain, tenderness and rigidity were marked, patient lay with legs and thighs flexed, expression was anxious, she had vomited once, and had a rapid thready pulse. On the thirteenth day she was seen by a surgeon who thought she had a perforation, but owing to her almost moribund condition, declined to operate. Death occurred shortly afterwards. Autopsy: Typhoid ulceration of the intestines, pin-head perforation in the ileum near the ileocæcal valve, with another perforation one cm. in diameter in the ileum 60 cm. above the ileocæcal valve, acute purulent peritonitis, pyæmic abscess of the kidneys, and œdema of the lungs.

CASE CXVII.—*Perforation. Operation. Death. Autopsy.*

Male, white, tailor, aged twenty-two years; hospital No. 1032; admitted June 29, 1910, on the seventeenth day of a severe infection, with a negative Widal and 7600 leucocytes. This patient had been very ill from the time of his admission and was very toxic. On the twenty-third day developed marked tenderness and rigidity over McBurny's point with marked acceleration of pulse and respirations, pulse 84 to 120 and respirations 32 to 44, without any marked change in the temperature. Leucocyte count soon

after the onset of pain was 8200 with 83 per cent. polymorphonuclears, two hours later there were 9200 leucocytes, and 5 hours before operation, 9200. Operation was done under ether anæsthesia, 28 hours after the onset of pain. A small perforation found in the ileum 3 inches from the ileocæcal valve. Perforation was closed and the abdomen drained with gauze. The patient did well for 5 days, when he became very sick, profoundly toxic, and died on the seventh day after operation. It was thought the cause of death was toxæmia from his typhoid. Autopsy showed extensive ulceration of the ileum, adhesive peritonitis, plastic pleurisy, splenic infarct, congestion of the lungs with a secondary perforation of the ileum, 5 mm. in diameter and 15 cm. above the ileocæcal valve.

CASE CXVIII.—*Perforation. Operation. Death.*

Male, white, driver, aged twenty-four years; hospital No. 1591; admitted August 16, 1910, on the eleventh day of a severe infection, with a positive Widal and 4800 leucocytes. The patient had been very sick but it looked as if he were nearing convalescence. On the twenty-third day he was seized with sudden severe abdominal pain after taking a glass of milk. This was accompanied by a chill, his pulse was elevated from 80 to 120, respirations from 24 to 36, temperature increased 3.2 degrees, his abdomen became generally rigid and tender, and he was operated upon 6 hours after the onset of pain under ethyl-chloride-ether anæsthesia, through a right rectus incision. A plastic peritonitis was found with purulent exudate. There was a perforation in the ileum near the cæcum the size of a pea. The abdomen was irrigated and drained with gauze; he did well for 5 days, when he developed lobar pneumonia of the right base, and died on the seventh day after operation without any unsatisfactory abdominal symptoms. No autopsy.

CASE CXIX.—*Perforation. Operation. Death.*

Male, white, clerk, aged seventeen years; hospital No. 1942; admitted September 20, 1910, on the twenty-first day of a severe illness, with a positive Widal and 9400 leucocytes. From the time of his admission he had a distended abdomen with diarrhœa. On the thirty-fifth day he suddenly developed severe abdominal pain with marked tenderness and rigidity of the abdomen in the right lower quadrant, vomited, became cyanotic, his pulse was very rapid and almost imperceptible, his respirations were hurried, and his temperature dropped 3 degrees. His leucocytes just before operation were 7450. Operation was done 2 hours after the onset of pain under ether anæsthesia through a right rectus incision. A small perforation was found in the ileum 8 cm. above

the ileocæcal valve. The ulcer was inverted, the abdomen was drained with gauze, and the patient never fully reacted from the shock attending the operation. Death occurred 22 hours after operation. No autopsy.

CASE CXX.—*Perforation. Operation. Death.*

Male, white, laborer, aged twenty-five years; hospital No. 2389; admitted October 28, 1910, on the seventeenth day of a moderately severe infection, with a positive Widal and 2900 leucocytes. This patient had almost continuous but not severe pain beginning on the eighteenth day. It was never severe but persistent and just enough to make the patient uncomfortable most of the time. On the twenty-fourth day it became a little more severe and he developed a little tenderness. He soon developed a little rigidity but there was never any severe outburst of pain and there was no change in his temperature, pulse, or respirations at any time, but owing to the persistent pain, tenderness, and rigidity it was thought that he probably had a perforation. Leucocytes just before operation were 3250. Operation was done 12 hours after his pain became worse under ether anæsthesia through a right rectus incision. There was considerable soiling of the peritoneal cavity, plastic peritonitis, and there was a perforation the size of a pea in the last portion of the ileum. It was closed, the abdomen was irrigated with salt solution and drained with gauze. Death occurred on the fifth day after operation, probably from peritonitis. Autopsy was not done.

CASE CXXI.—*Perforation. Operation. Death.*

Male, white, laborer, aged thirty-four years; hospital No. 4446; admitted April 12, 1911, on the sixteenth day of a moderate infection. This patient had been feeling ill with headache and general malaise for two weeks and stated that he had had abdominal pain for the last 8 days previous to admission. He was referred to the hospital and diagnosed as acute appendicitis. There was no history of sudden acute abdominal pain elicited. On admission his abdomen was distended, generally rigid and tender, he had a temperature of 101°, and presented the picture of general peritonitis. It was thought that he probably had typhoid fever with perforation. Operation, ethyl-chloride-ether anæsthesia, soon after admission, the abdomen was opened through the right rectus, diffuse peritonitis was found with effusion of the intestinal contents and adhesions about the last portion of the ileum and cæcum. A perforation was found in the ileum, near the cæcum, 2 mm. in diameter. It was inverted with a purse-string suture, the abdomen was irrigated, and rubber-covered gauze

drainage instituted. Death on fourth day after operation, probably resulting from peritonitis. No autopsy.

CASE CXXII.—*Perforation. Operation. Death.*

Male, white, barber, aged twenty-two years; hospital No. 750; admitted May 30, 1911, on the eighteenth day of a severe typhoid, negative Widal, and 5400 leucocytes. His abdomen was distended and he had diarrhœa with considerable toxæmia from the time of his admission. This patient on the twenty-second day "developed symptoms of peritonitis." Operation was done soon after under ethyl-chloride-ether anæsthesia. A small perforation was found which was closed, the abdomen was irrigated and drained. On the second day after operation developed pneumonia and died on the fourth day, probably as a result of the pneumonia. No autopsy.

CASE CXXIII.—*Perforation. Operation. Death.*

Male, white; hospital No. 2102; admitted September 20, 1911, on the eighteenth day of a moderate infection, with a positive Widal and 6500 leucocytes. On the twenty-third day (P.M.) patient had pain, but not severe, in the right iliac fossa with tenderness and slight rigidity, but the abdomen was not distended. His general condition was good, there was no pulse change, leucocytes 15,600. During the night he had two attacks of sharp pain of only a few minutes duration, next morning he had dull pain, a little tenderness and slight rigidity. His leucocytes were again 15,600. He was seen by a surgeon and operation was considered but deferred because it was thought that he probably had not a perforation. He slept soundly during that night, but vomited twice early next morning, had hiccoughs, his abdomen had become more rigid and tender, it was now distended, his pulse rate had increased and his temperature was slightly fluctuating. His leucocyte count at that time was 2200. Thirty hours after onset of pain operation was done under ether anæsthesia, right rectus incision. The peritoneal cavity was filled with fluid and intestinal contents, there was general peritonitis with a small perforation in the ileum a few inches from the cæcum. The abdomen was irrigated, the wound closed, death 6 hours later. No autopsy.

CASE CXXIV.—*Perforation. Operation. Death.*

Male, white, ship rigger, aged twenty-two years; hospital No. 1091; admitted July 4, 1912, on the fifth day of a severe infection, with a positive Widal, positive blood culture for typhoid bacilli, 7300 leucocytes, a distended abdomen and slight diarrhœa. This patient had gone through a short but severe typhoid with a persistently high temperature. On the nineteenth day, his temperature having been normal for 4 days, he had a severe chill and

developed severe abdominal pain with localized tenderness and rigidity in the right lower quadrant. He had marked acceleration at this time of pulse and respiratory rate, his leucocytes soon after the chill were 5200 with 68 per cent. polymorphonuclears. He was watched by the attending physician for 2 hours, during which time his symptoms abated, his condition seemed much improved and operation was deferred. At the end of 12 hours from the onset of his pain, he became worse, with increased tenderness and rigidity, leucocytes 12,000 and 88 per cent. polymorphonuclears. Operation under ethyl chloride anæsthesia through a right rectus incision. There was much free fluid in the abdomen and a pin-head perforation was found in the ileum half an inch from its juncture with the cæcum. The point of perforation seemed to have become adherent; it was closed, the abdomen was irrigated, and gauze drainage instituted. Patient did well for 4 days, except for a profuse intestinal hemorrhage shortly after operation, but died on the sixth day, probably from pneumonia. This patient had had typhoid 5 years before. No autopsy.

CASE CXXV.—*Perforation. Operation. Death. Autopsy.*

Female, white, housework, aged twenty-one years; hospital No. 1747; admitted September 3, 1912, on the twenty-first day of a severe infection, with a positive Widal and 5900 leucocytes. The abdomen was distended, she had diarrhœa, with two profuse hemorrhages after admission. On the thirtieth day she developed lobar pneumonia but before this she had been profoundly toxic. On the thirty-seventh day she had a severe chill, circulatory collapse, and cyanosis. Her temperature dropped 3 degrees with a subsequent 4-degree elevation. On the following morning marked abdominal tenderness was noted with increased distention and general rigidity. Perforation was diagnosed. Her leucocytes at this time were 17,600. The abdomen was opened through a median suprapubic incision, there was much purulent fluid with lymph over the intestines and a small " punched-out " perforation in the ileum an inch from the ileocæcal valve. The loop bearing the perforation was brought into the wound, sutured to the skin, and the perforation enlarged. The wound was drained and Murphy treatment instituted. The patient died a few hours later. Autopsy revealed extensive ulceration of the ileum with a general purulent peritonitis and another small perforation in the ileum, 18 inches above the ileocæcal valve.

CASE CXXVI.—*Perforation. Operation. Death.*

Female, white, cook, aged twenty-nine years; hospital No. 1346; admitted July 21, 1913, on the fourteenth day of a very severe infection, with a positive Widal and 8100 leucocytes. This

patient was profoundly toxic and had marked abdominal distention with diarrhœa, from the time of admission. At the time of her admission it was noted that she had marked pulmonary involvement, with "signs suggesting a typical pneumonia with decided meningeal symptoms." On the thirty-eighth day she had severe sudden abdominal pain, marked tenderness and rigidity of the right lower quadrant, anxious expression, severe shock with cyanosis, obliterated liver dulness, increased pulse rate from 112 to 150, and very weak increased respiratory rate. Operation soon after under ether anæsthesia, right rectus incision. On opening the peritoneum there was found marked effusion of the intestinal contents with a perforation, the size of a dime, in the ileum, location not stated. This portion of the intestine was brought into the wound and anchored with a suture and gauze. The perforation was not closed and the pelvis was drained through a suprapubic stab wound. Died 24 hours later. No autopsy.

Case CXXVII.—*Perforation. Operation. Death.*

Male, white, manufacturer, aged twenty-seven years; hospital No. 1638; admitted August 11, 1913, on the twelfth day of a severe typhoid, with a positive Widal and 10,100 leucocytes. The abdomen was distended on admission. This patient on the seventeenth day complained of rather severe pain with tenderness in the right upper quadrant of the abdomen, he vomited once or twice, and there was rigidity of the right upper rectus. The attending physician thought that he had a cholecystitis. This condition persisted, his pain and tenderness becoming a little more generalized, with leucocytes 13,400 on the day of onset. His pulse increased from 88 to 120, respirations from 24 to 36, and his temperature was slightly remitting in character. Forty-eight hours after the onset of pain, tenderness and rigidity became much more marked, his liver dulness was obliterated with evidence of fluid in the peritoneal cavity. His leucocytes the day before were 12,700 and just before operation, 14,700. Operation under ether anæsthesia 48 hours after onset of pain, right rectus incision. On opening the peritoneum diffuse purulent peritonitis was found with effusion of intestinal contents and a perforation 2 cm. in diameter in the ileum, 12 inches above the ileocæcal valve. Inversion of the ulcer was attempted but the sutures would not hold and the loop of intestine bearing the perforation was brought into the wound, surrounded with gauze, and the abdomen drained after irrigation, with a rubber-covered gauze drain, with a small suprapubic stab drain in the pelvis. Death occurred 6 hours later. No autopsy.

Case CXXVIII.—*Perforation. Operation. Death.*

Male, white, laborer, aged thirty-one years; hospital No. 1848;

admitted August 31, 1913, on the eighth day of disease, with a severe infection, a negative Widal and 5400 leucocytes. On the thirteenth day he was seized with sudden severe abdominal pain with tenderness and rigidity in the right lower quadrant "his temperature dropped, and pulse and respirations were much increased." It was thought that he had a perforation and operation advised, which was done under ether anæsthesia. A pin-head perforation was found in the ileum, location not stated; perforation was closed, and abdomen drained with gauze. Patient reacted poorly from the shock of the operation and died 17 hours later. No autopsy.

CASE CXXIX.—*Perforation. Death. Autopsy.*

Male, white, student, aged fourteen years; hospital No. 2814; admitted November 13, 1913, on the sixth day of a moderate infection, with a positive Widal and 4200 leucocytes. This patient was not very ill but his course was protracted, abdomen distended a great deal of the time, had diarrhœa with several slight hemorrhages during the fifth week. On the fortieth day he was in fairly good condition when he developed sudden severe, cramp-like pain in the epigastrium, which was later referred to the right iliac fossa. He had several recurring attacks without change in pulse. His temperature dropped, however, from 102° to 98°, he developed tenderness over both lower quadrants, but more marked over the right. He was seen by a surgeon 8 hours later, perforation was diagnosed, but operation was declined on account of his extreme condition. Death occurred the next day. Partial autopsy revealed general peritonitis with extensive ulceration of the ileum and a pin-head perforation 3 inches above the ileocæcal valve. Many other ulcers had extended to the peritoneal covering.

CASE CXXX.—*Perforation. Operation. Death. Autopsy.*

Male, white, salesman, aged forty years; hospital No. 2021; admitted July 7, 1914, on the tenth day of a very severe infection, with a positive Widal and 5600 leucocytes. From the time of his admission he had abdominal distention and diarrhœa. On the thirteenth and fourteenth days he had 4 profuse intestinal hemorrhages. On the fourteenth day he was seized with severe, cramp-like pain in the umbilical region and over the lower abdomen. His pulse and respirations were markedly accelerated. With this he developed great rigidity and tenderness of the lower abdomen which soon became generalized, leucocytes were 9200, peristalsis was diminished, there was obliteration of liver dulness, and he was considerably shocked. Operation was done two hours after onset of pain, the abdomen being opened under local anæsthesia and concluded under ethyl chloride anæsthesia. Two perforations

were found in the ileum, one, 1 cm. in diameter, 6 inches above the ileocæcal valve, and the other, pin-head in size, 2 feet above the ileocæcal valve. There was much leakage of intestinal contents, the perforations were closed, the abdomen was irrigated with salt solution, and rubber-covered gauze drainage instituted. He did well for 36 hours, then began to fail, and died 50 hours after operation. Autopsy revealed diffuse peritonitis, no other perforation, congestion of the lungs and liver, acute splenic tumor, and acute parenchymatous nephritis.

CASE CXXXI.—*Perforation. Operation. Death. Autopsy.*

Male, white, iron worker, aged twenty-four years; hospital No. 2153; admitted July 18, 1914, on the seventh day of a severe infection, with a positive Widal and 4800 leucocytes. The patient had been quite sick and very toxic from the time of admission. On the seventeenth day his abdomen became more distended and a little later he developed sudden severe, cramp-like abdominal pain with increasing distention, with generalized rigidity and tenderness, both being more marked in the lower right quadrant. There was no marked change in pulse, temperature, or respirations. His leucocytes on the day before operation were 4000 and the differential count showed 65 per cent. polymorphonuclears, 10 per cent. mononuclears, 23 per cent. small mononuclears, and 2 per cent. eosinophiles. Just before operation there were 4200 leucocytes with 75 per cent. polymorphonuclears. Soon after this he was operated upon under ethyl-chloride-ether anæsthesia, right rectus incision. No perforation was found, there were many deep ulcers in the ileum and one might be described as being in the pre-perforative stage and was inevrted with a purse-string suture; peritonitis was present but its extent was not stated. The abdomen was then drained with a rubber-covered gauze drain. Patient did not do very well after the operation; developed a right basal pneumonia and died on the fourth day after operation. A partial autopsy showed that the pre-perforative ulcer had sloughed and perforated. There was also another perforation near this, pin-head in size, with a diffuse peritonitis.

CASE CXXXII.—*Perforation. Operation. Intestinal obstruction. Secondary operation. Death. Autopsy.*

Male, white, farmer, aged twenty-one years; hospital No. 2255; admitted July 25, 1914, on the twenty-sixth day of a severe infection, a positive Widal and 4200 leucocytes. This patient had a primary attack of 36 febrile days and was then convalescent until the forty-seventh day, when his temperature rose to 103°, remaining up for 10 days and reaching normal again on the fifty-seventh day. During this time he had considerable abdominal

distention. His temperature remained normal again until the seventieth day, apparently convalescent again, in good physical condition, and fairly well nourished. During the last 6 days of this afebrile period, he had slight diarrhœa, 4 or 5 movements daily, he had been out in a chair for 3 successive days, and was on extra diet, when he developed slight abdominal pain which he did not report for 6 hours. At the end of that time it suddenly became very severe, the abdomen tender and rigid over both lower quadrants, but more marked over the right, peristalsis was practically absent, he had a severe chill with a 5-degree elevation of temperature, liver dulness was obliterated, expression anxious, his hands were cyanosed, and he looked as if he were suffering from shock, but the pulse and respiratory rate had not changed. Two hours after onset of severe pain he was operated upon under ether anæsthesia and a perforation was found in the ileum 2 inches above the ileocæcal valve. The abdomen was irrigated and rubber-covered gauze drains used for drainage and the section of the intestine bearing the perforation was drawn into the wound, the perforation enlarged, and a fistula established after the method employed by Hays. He did well for 3 days when he developed intestinal obstruction, for which he was operated upon the second time. It was found that a band across the last loop of the ileum was the cause of the obstruction, which was relieved. He died 36 hours later from peritonitis. Partial autopsy was done and revealed diffuse peritonitis with another perforation in the cæcum.

CASE CXXXIII.—*Perforation. Operation. Recovery.*

Male, white, factory worker, aged twenty-one years; hospital No. 2647; admitted August 31, 1914, on the twenty-first day of a severe typhoid, with a negative Widal and 7000 leucocytes. He had rather marked abdominal distention and slight diarrhœa from the time of his admission. On the twenty-eighth day he was suddenly seized with recurring cramp-like pain; he vomited once; his abdomen became very tender and rigid in the right iliac fossa; there was no change in his pulse or respiratory rate, or his temperature; there was marked tenderness on rectal examination, and just before operation his leucocytes were 12,000 with a differential count of 87 per cent. polymorphonuclears, 3 per cent. large mononuclears, 10 per cent. mononuclears. Operation was done 7 hours after onset of pain, which for the first two hours had been slight, then became severe, cramp-like and recurring. A pin-head perforation was found in the ileum 6 inches from the ileocæcal valve. It was closed, and the abdominal wound closed without drainage. He did well for 6 days, when he had frequent vomiting with increasing abdominal distention and considerable pain. It was

thought that he had an obstruction. Under ethyl chloride anæsthesia the wound was opened, the presenting loop of small intestine was walled off with gauze, and it was then opened with a cautery establishing a fistula. Much gas and fecal matter escaped, relieving the patient. He continued to do well and the wound slowly healed, although it was probably in the lower jejunum, and he was discharged cured on the one hundred and twenty-eighth day after operation.

CASE CXXXIV.—*Perforation. Operation. Death.*

Male, white, laborer, aged thirty-eight years; hospital No. 2827; admitted September 19, 1914, on the twenty-first day of an ambulatory typhoid. No record of Widal or leucocytes. This patient had been sick for about 3 weeks with the usual symptoms of a mild typhoid. During most of this time he worked. Two days before admission to the hospital, while he was sitting in a chair, he was seized with severe abdominal pain which he says persisted. On admission his temperature was 103° with marked generalized tenderness and rigidity, liver dulness was obliterated, and the patient was in an almost moribund condition. Operation was done under ether anæsthesia and a large perforation found in the ileum 3 inches above the ileocæcal valve with diffuse peritonitis. Perforation was closed, the abdomen was irrigated and drained with a rubber covered gauze drain. He died about 15 minutes after the operation.

CASE CXXXV.—*Perforation. Operation. Recovery.*

Male, white, salesman, aged thirty years; hospital No. 2964; admitted October 2, 1914, on the tenth day of a moderate infection, with a positive Widal and 7000 leucocytes. His abdomen was distended most of the time after admission. On the twelfth day he developed sudden cramp-like pain recurring at short intervals, with tenderness and rigidity over both lower quadrants, more marked on the right side, and without change in pulse or respirations. There was a 2-degree drop in temperature at the onset of pain with a 4-degree elevation shortly afterwards. His leucocytes were 7400 and there was marked rectal tenderness with dulness in the right flank. In about 10 hours from onset of first pain he was operated upon, ether anæsthesia. A perforation was found in the ileum 3 inches above the ileocæcal valve, size not stated. The abdomen was drained with rubber covered gauze drains. Patient stood the operation well, running a moderate febrile course without complications for 23 days after operation. At this time his wound had practically healed and he was discharged from the hospital cured on the thirty-ninth day after operation.

CASE CXXXVI.—*Perforation. Operation. Recovery.*

Male, white, factory worker, aged seventeen years; hospital No. 3239; admitted October 25, 1914, on the twelfth day of a severe infection, positive Widal and 5000 leucocytes. On the nineteenth day he had abdominal pain with a chill, 3-degree elevation of temperature, 20 per cent. increase in pulse rate, with abdominal distention, leucocyte count of 9200 at the onset of pain with a subsequent count of 9600. His pain was not very severe but there was marked tenderness on palpation, peristalsis was much diminished, liver dulness was diminished, but its obliteration was doubtful. Operation about 6 hours after onset of pain under ethyl-chloride-ether anæsthesia through a right rectus incision. A small perforation was found in the ileum 3 inches above the ileocæcal valve. The abdomen was drained with a rubber tube which extended into the pelvis. The patient continued an uncomplicated febrile course for 14 days after operation, there was considerable drainage from the wound for the first few days and he was discharged cured on the forty-second day after operation.

CASE CXXXVII.—*Perforation. Operation. Recovery.*

Male, white, laborer, aged twenty-three years; hospital No. 3269; admitted October 27, 1914, on the sixth day of a moderate infection, with a positive Widal and 3800 leucocytes. On the tenth day after a bowel movement the patient complained of rather severe abdominal pain and tenderness. Soon after the onset of pain he vomited, developing rigidity of the recti which was more marked over the right upper rectus than over the right iliac fossa. He also had decided tenderness and resistance in the right flank and loin. He lay with both knees drawn up; peristalsis was diminished, and there was little if any change in the liver dulness. There was no decided change in the pulse (100) or respiratory rate and no temperature change. His leucocytes were 5000. Operation was done as soon as he could be prepared, under ethyl-chloride-ether anæsthesia, through a right rectus incision. A pin-head perforation was found in the ileum 12 inches above the ileocæcal valve. Perforation was closed and drainage was established through a rubber tube which extended into the pelvis. He continued a mild febrile course for 14 days after operation, he was then convalescent for 10 days, when he had a mild relapse from the twenty-fourth to the forty-first days after operation, after which he made an uneventful recovery. Discharged cured on the sixtieth day after operation.

CASE CXXXVIII.—*Perforation. Operation. Death. Autopsy.*

Male, white, laborer, aged nineteen years; hospital No.

3865; admitted December 22, 1914, on the fifth day of a severe typhoid, a positive Widal and leucocytes. This patient was very sick and profoundly toxic from the day of his admission, his abdomen was distended, he had diarrhœa and 8 hemorrhages from the tenth to the thirteenth days, totalling 56 ounces. On the thirteenth day he developed sudden severe abdominal pain lasting for about half an hour, with subsequent generalized rigidity and tenderness with marked acceleration of the pulse and respirations and a 4-degree drop in temperature. On the day before perforation his leucocytes were 7100, just after the onset of pain they were 11,000. Operation was done soon after the onset of pain, the abdomen being opened under local anæsthesia and the operation concluded under ethyl chloride. There was much leakage of intestinal contents and a perforation was found in the ileum 12 inches from the ileocæcal valve. It was closed and a rubber drainage tube inserted into the pelvis. His condition became very critical on the table and he was given salt solution and adrenalin intravenously. He died 10 hours later. A partial autopsy revealed general peritonitis without any other perforation.

CASE CXXXIX.—*Perforation. Operation. Recovery.*

Male, white, milkman, aged twenty years; hospital No. 38, admitted January 14, 1915, on the ninth day of a moderate infection, with a very suggestive Widal and 8800 leucocytes. On the eleventh day he developed sudden severe paroxysmal pain in the abdomen, lasting three to five minutes and recurring at ten- to fifteen-minute intervals, without rigidity and but slight tenderness between the first two paroxysms, both pain and tenderness becoming more marked after this. The pain was referred to the penis and the right iliac fossa, tenderness in the right iliac fossa was decidedly increased on turning the patient to the left side, liver dulness was diminished and there was decided tenderness on rectal examination. There was no appreciable change in pulse or respirations, and no change in temperature. The abdomen was slightly distended, peristalsis was active at first but was soon very much diminished. During one of the attacks of pain he had a normal bowel movement which increased the pain considerably, his expression soon became anxious, which was not noted at the onset of pain, his respiratory movements became thoracic and his leucocytes just before operation were 11,100. Operation was done 3 hours after the onset of pain under ethyl-chloride-ether anæsthesia, through a right rectus incision. On opening the peritoneum considerable fluid was found with a small amount of fecal matter. A pin-head perforation was found in the ileum 12 inches above the ileocæcal valve. It was closed

and the abdomen was drained through a rubber tube which extended into the pelvis. His condition was good at the conclusion of the operation, pulse 120 on returning to the ward and was 88 just before the operation. The febrile course of the disease seemed uninterrupted by the operation, his temperature became normal on the tenth day after operation, remaining normal for 7 days, then he had a relapse running a moderate fever for 2 weeks. After this he made an uneventful recovery and was discharged cured on the forty-fifth day after operation.

Symptoms.—A rehearsal of the symptoms of typhoid perforation would seem unnecessary and of little use because I believe our errors result not from any lack of knowledge regarding the symptoms but rather from a hesitancy to comprehend the importance of promptly acting when these symptoms present themselves. The two most valuable symptoms are pain and rigidity, and on these two symptoms we must rely nearly altogether. Of course if the pain comes on suddenly and the rigidity is marked, a perforation must be suspected and exploration made. From a study of our cases I think the mistake of attributing the pain and rigidity of a thoracic lesion to a perforated ulcer is unlikely, but of course a careful examination of the chest should always be made. Sudden severe pain and board-like rigidity indicate a perforation of some size with considerable leakage and the diagnosis is comparatively easy. The less sudden and less severe the pain and rigidity, the more difficult the diagnosis becomes. Digital examination per rectum should always be made and often will reveal acute tenderness, which is of great significance. Difficult, painful or frequent urination often occurs. Changes in pulse rate and temperature are of no great diagnostic value and the sudden fall of temperature with an increased pulse rate often means hemorrhage. Our case records do not show the extensive use we have made of blood counts in these cases but we are convinced that the absence of a leucocytosis is of no diagnostic value. As a rule, it takes from eight to twelve hours for the average case of perforation to develop a leucocytosis. The presence of a leucocytosis, of course, is of diagnostic value. We have learned to put little faith also in the presence or absence of liver dulness, but if the liver dulness is absent and the abdomen is flat, perforation probably has taken place.

Treatment.—When the symptoms are sufficient to make the attending physician and surgeon believe that a perforation has probably occurred, there should be no delay in operating. I am sure that my own mistakes have been in this connection and I believe the cases here reported clearly show that delay, after the onset of pain and rigidity, is

the cause of the high mortality following operations for perforation in typhoid fever. It has not been our experience that a quick exploration does much harm, even where no perforation is present, in the large majority of cases a definite cause for the symptoms is found and justifies the exploration.

At the present time when there is so much controversy regarding the type of anæsthetic, one hesitates to attempt to lay down any rule. Infiltration anæsthesia preceded by morphia and atropine certainly offers the safest means of confirming the diagnosis and in the majority of instances is quite sufficient for the entire operation. In several of my own cases the operation throughout has been conducted under chloride of ethyl anæsthesia. I can readily understand why some would prefer gas alone, or gas and oxygen. The frequent development of lung complications after these operations convinces me that ether anæsthesia increases the hazard. It seems needless to say that the duration of anæsthesia should be as brief as possible and that the operation itself should be conducted with expedition; 10 or 15 minutes will suffice in the majority of instances. Many of these cases are lost because the patients are completely anæsthetized, often with ether, before the surgeon is ready to begin the operation. The safest rule is to open the abdomen under infiltration anæsthesia and administer a general anæsthetic only if it is necessary, and then for as brief a time as possible.

The question of how the perforation itself should be treated is still a matter of controversy. In the cases here reported, a closure of the perforation with drainage of the abdomen has been the rule, but in a number of cases the perforated bowel has been sutured in the wound and allowed to drain. Hays of Pittsburgh (*Penna. Medical Journal*, 1908) advocates very strongly the performance of enterostomy, and his personal statistics bear out the value of this method. Hutchinson of the Pennsylvania Hospital also advocates this method.

Hays has operated upon 38 cases with a recovery rate of 36 per cent., which constitutes the best report with which I am acquainted.

The question of irrigation and the type of drainage must be left largely to the operating surgeon to decide. Personally I do not like irrigation and always employ a rubber covered drain. Continuous enteroclysis is the most important part of the after-treatment. The Fowler position, although of great help in many cases of perforative peritonitis, is not always advisable in typhoid fever, as the patient is often too weak to stand it. Hays employs a glass drainage tube, but I have always felt that the rigid unyielding tube is apt to give rise to adhesions and subsequent obstruction.

Post-operative Course.—Most of the deaths that occur within a few hours may be attributed to shock and toxæmia. Those occurring late result from lung complications and from peritonitis. One of our series died two weeks after operation from double parotid bubo. Secondary perforations are frequent and are usually fatal, because they are not recognized. Three of our cases were operated upon a second time, one for perforation and two for obstruction. There were 26 autopsies made in our fatal cases and in 14 of them secondary perforations had occurred. In 2 cases there was a sloughing of a repaired ulcer and in 2 other cases there was sloughing and also a secondary perforation. One of our successful cases operated upon by Harte had 2 perforations in the ileum, one in the appendix, and 3 distinct relapses after operation. This case illustrates the resistance sometimes shown in bad cases of typhoid. In 2 cases 5 distinct perforations were found at operation. In one case the perforation was repaired and the abdomen closed without drainage, a fecal fistula developed and later a pelvic abscess, which was drained through the rectum, and the patient recovered.

FREQUENCY OF CHEST COMPLICATIONS AMONG THE WOUNDED

By Kenneth Taylor, M.D.

PATHOLOGIST, AMERICAN AMBULANCE, PARIS, FRANCE

In view of the frequent occurrence of pathological lung conditions revealed at routine autopsies in this Ambulance (The American Hospital of Paris), it was decided to review the total number of autopsies on record with the idea of ascertaining the frequency of pathological conditions of the lungs and pleura among the fatal cases.

Fifty-one autopsy reports have been examined, comprising all in which an examination of the chest was made. The following is a list of the number of times in which a pathological condition was recorded:

Lobar pneumonia	6
Bronchopneumonia	15
Plastic fibrinous pleurisy	27
Pleurisy with effusion	8
Empyema	2
Passive congestion (extensive)	2
Hæmothorax	4
Pneumothorax	1
Negative findings	9

Many of the cases presented several conditions; for instance, five out of six of the lobar pneumonias showed adherent pleura, while nine out of the fifteen bronchopneumonias showed a similar condition. The total number of lesions is therefore in excess of the number of cases autopsied.

An attempt has been made to classify the injuries, taking those which seemed most directly responsible for the death of the patient. The following is a list of the occurrence of such injuries:

	Number of cases	Lungs negative
Penetrating wounds of chest	5	
Penetrating wounds of abdomen	4	1
Transverse lesions of cord	4	
Penetrating wounds of brain	10	3
Wounds of thigh	17	1
Wounds of leg and other extremities	6	2
Multiple wounds—too numerous to classify	4	2

Combining the list of injuries with the list of lung findings, we find that 43 showed definite microscopical pathology: In all of the 5 penetrating chest wounds; in 4 of the 5 penetrating wounds of abdomen; in 3 of the 4 cord injuries; in 6 of the 10 brain injuries; in 16 of the 17 wounds of the thigh; in 6 of the 8 wounds of other extremities; and in 4 of the 6 cases of multiple wounds pathological conditions of the lungs or pleura were present.

The distribution of these lesions may also be seen in the following chart.

Diagnosis	Lobar pneumonia	Broncho-pneumonia	Plastic fibrinous pleurisy	Pleurisy with effusion	Empyema	Hæmothorax	Congestion	Pneumothorax	Negative
Chest (5)...	..	1	3	2	..	3	..	1	..
Abdomen (4)	1	1	2	..	..	1	..	..	1
Cord (4)....	1	2	2	1	1	..	..	..	..
Brain (10)..	2	1	4	2	..	..	..	..	3
Thigh (17)..	1	6	9	3	..	..	2	..	1
Other extremities (6)	1	2	5	..	1	..	..	..	2
Multiple (4)	..	2	2	..	..	..	..	..	2

Further analysis of the 9 negative cases which occurred (1 in a penetrating wound of abdomen, 3 in penetrating wounds of brain, 1 in a wound of thigh, 2 in wounds of other extremities and 2 in cases with multiple wounds) shows that 4 died within five days of injury, a time too short for chronic changes of the lungs to have taken place.

The cases in which pathological lung conditions are certainly to be expected are, of course, those in which there is a penetrating wound of the chest and probably also the high transverse lesions of the cord—which together comprise 9 of the 43 cases showing pathological conditions. This leaves a total of 31 cases out of 51 autopsies in which the lung condition seemed to bear no direct relation to the wound. Some of these, especially a few of the acute bronchopneumonias, are undoubtedly to be explained as part of a general pyæmia or septicæmia. On the other hand, there is left a large proportion of cases in which it is difficult to see any direct relation between the wound and the condition in the chest. The high occurrence of lung conditions in wounds of the thigh (16 out of 17, 94 per cent.), as in penetrating wounds of the abdomen (4 out of 5) and in transverse lesions of the cord (4 out of 4), suggests that the chronic degenerative changes manifested in the great number of adherent pleuræ may possibly be connected with the matter of posture as well as the general intoxication from the wound itself.

Presumably the acute lung conditions were more or less dependent upon the chronic changes in the pleura.

It is worth noting that this high incidence of pathological lung conditions has occurred in a class of patients which should be fairly free from lung affections; all are men between the ages of twenty and forty, who are supposed to have passed a more or less rigid medical examination and who have been living an out-door life for several months.

In conclusion it may be stated that 90 per cent. (46 of of 51) of the wounded dying five days or more after injury have shown at autopsy some gross pathological condition of the lungs or pleura sufficiently marked to be more or less active in preventing recovery from the wound. In more than half (27 out of 51) of these this change was of a chronic degenerative character, unexpected in civil practice in patients of this age and state of health. By far the greatest number of cases was in the type of wound enforcing a dependent position in bed.

THE TRANSVERSE ABDOMINAL INCISION

By Willy Meyer, M.D.
of New York
ATTENDING SURGEON TO THE GERMAN AND POST-GRADUATE HOSPITALS

In the course of the last months I have carried out in a number of cases the transverse abdominal incision, as originally recommended by Sprengel of Braunschweig,[1] and later worked out by Perthes, of Tübingen.[2]

I came to employ it as a result of the experience gained in two cases of resection of the cardia in which access to the vault of the diaphragm had to be obtained in the presence of a gastric fistula. The oblique cut gave a better access to major and lesser curvature towards the cardia than any longitudinal, even one through the outer fibres of the left rectus, could have offered, although the latter muscle could not be divided in order to preserve the gastric fistula. I then decided to try the transverse incision for stomach operations, as had been repeatedly urged by other surgeons before.[3]

In one case I first tried the approach through a left oblique entrance, which, however, had to be transformed into an acute angle with rounded tip by unforeseen local conditions within the abdomen. Fig. 1 shows the peculiar incision, which was done for resection of the greater portion of the stomach for carcinoma. Firm and broad adhesions to the lower surface of the liver and gall-bladder, evidently due to an old ulceration, forced me to continue the first left oblique cut through the right rectus and transversalis muscle and part of the obliques. When completed, the incision, therefore, ran parallel to the costal arch on either side. The flap could be nicely turned downward, affording splendid access for thorough work; nor did I have any difficulty in replacing it and closing the abdomen. Final cicatrix is strong; no tendency to hernia.[4]

[1] Verhandl. d. Deutschen Gesellsch. f. Chirurgie, 1910, vol. 39, II, p. 95.

[2] Deutsche Zeitschr. f. Chir., vol. 129, page 493, and Centralbl. f. Chir., 1912, No. 37.

[3] Moschcowitz, A. V.: Transactions of the New York Surgical Society, April, 1915, page 495.

[4] See Annals of Surgery, Report of Transactions of the New York Surgical Society, May 12, 1915.

Figs. 2 and 3 show the " typical transverse incision " at the junction of middle and lower third of a line drawn from the xiphoid process to the umbilicus.[4]

Fig. 4 demonstrates how, by swinging the left extremity of the cut around, the right rectus muscle can be entered and the appendix and gall-bladder reached, if required. The illustration was taken from a patient in whom a duodenal ulcer was suspected, but not found; hence it became necessary to explore the gall-bladder and appendix region. The appendix could be well removed, though it proved to be quite firmly adherent in the small pelvis.

After a skin incision in a transverse, slightly convex-upward direction has been made, the abdomen is entered in the middle line. The left forefinger is introduced through the peritoneal button-hole, and three catgut sutures are placed in a horizontal line about three-fourths of an inch apart with a round curved needle above and below (Fig. 5). They grasp rectus fascia and rectus muscle, but not the peritoneum. The finger pressed against the parietal peritoneum from within, guards it from being caught by the needle. Whilst the operator puts in the second suture the assistant ties the first one, and so on. The six sutures on the left having been finished, the surgeon turns his left forefinger for 180 degrees, making a pronounced pronation, and proceeds in the same way to the right of the median line, until the two rows of sutures have been put in on either side (Fig. 6).

Now the finger is withdrawn and the original line of skin incision deepened into the abdomen. The belly of the recti muscles having been fixated to the anterior sheath of the rectus fascia, retraction of their fibres is impossible (Fig. 7).[5]

Most excellent access is thus gained. By pulling the stomach downward, the lesser curvature particularly becomes well accessible.

By dividing the left or right rectus only, the transverse incision can be nicely used for exploratory palpation and inspection. If more room be needed for a subsequent operation, the inner end of the incision can be swung upward into the median line and run up to the xiphoid (Perthes).

When closing up it is gratifying to note how nicely the different layers of the abdominal wall can be approximated, more so, if the upper part of the body is slightly raised on the operating table. A continuous chromicized catgut suture unites peritoneum plus transverse fascia; the

[5] Figs. 5 and 7 have been reproduced from Perthes' article in the Centralbl. f. Chir., l. c., No. 5 has been slightly modified.

FIG. 1.

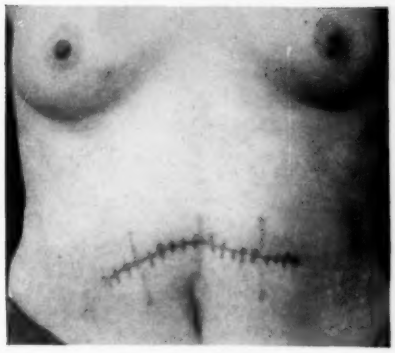

FIG. 2.

FIG. 3.

FIG. 4.

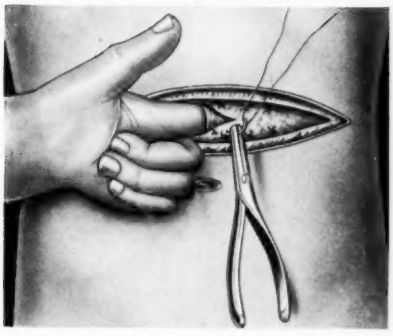

FIG. 5.

FIG. 6.

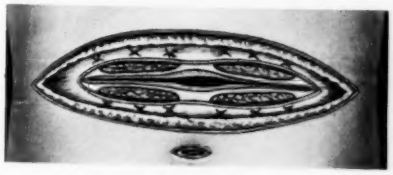

FIG. 7.

second layer of buried continuous suture approximates the divided muscles, the needle catching the facia (muscles) *to the outside* of the fixation sutures originally placed; the third layer closes the skin.

Retention sutures, which I put in at first, are not required, as the tendency of the abdominal wall, in case of vomiting, coughing or sneezing, is to approximate rather than separate the borders of the wound.

I have tried this incision now in eight cases and have been so favorably impressed with it, that I feel it should be more frequently used.

THE CLOSURE OF MUCOCUTANEOUS FECAL FISTULÆ*

By Edwin Beer, M.D.
of New York City
(From the Surgical Service of the Mount Sinai Hospital)

It is a well-recognized fact that, owing to the difficulty of closing a fecal fistula, no simple and classical method of operating on this pathological condition has been developed. Moreover, the methods of procedure described in the various text-books bear evidence to the fact that surgeons frequently have to use all their ingenuity to effect a closure of such a fistula. This paper is written with the object of calling attention to a simple and non-dangerous method[1] of closing a common type of fecal fistulæ, and I believe that if it should prove as satisfactory to others as it has been to me, these lines will go far in the direction of establishing a classical operative technic.

Every surgeon who has dealt, extraperitoneally, with fecal fistulæ of the small and of the large bowel, fecal fistulæ in which the intestinal mucosa and skin are in apposition (and to this type alone my paper refers), must have noticed that though using the identical technic, in one case a permanent closure is effected and in the next case the operation fails. I have seen this again and again. Gradually it dawned upon me that the cases that were immediately successful and those that broke open but subsequently closed, had one point in common, *i.e.*, the suture line in the gut was at a considerable depth from the skin and more or less covered by the subcutaneous fat drawn over it by the cutaneous suture. The great value of this subcutaneous fat as well as of the wide separation of skin and suture line in the gut, I came to recognize fully. To insure this separation of suture line and skin, and to definitely cover the suture line with healthy subcutaneous fat, the following operation was devised. In closing defects in the rectal suture line after resection, Enderlen applies a similar method with success.

The underlying principle of this operative procedure is to separate the suture line from the skin by a layer of healthy adipose tissue and in this way either obtain a primary closure of the opening in the gut or, in case this fails, to promote a secondary closure by making the resulting sinus an oblique and tortuous one. The operation is extraperi-

* Lippen Fistel of the Germans.

[1] First described before the N. Y. Surgical Society, Ann. Surg., 1915, lxi, 110.

FIG. 1.—Circumcision of fistula at muco-cutaneous margin; incision through skin and subcutaneous fat above and below fistula.

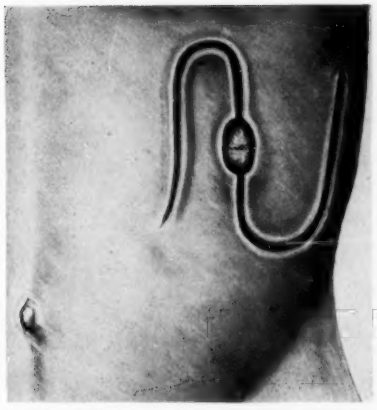

FIG. 2.—Transverse suture of stoma in gut; fashioning of two unequal skin-fat flaps on either side of closed stoma.

FIG. 3.—Shifting of skin-fat flaps so that broader one covers sutured stoma; attachment of these flaps with few skin sutures in new positions.

toneal, very simple and can be done readily under local anæsthesia. I have tried it in the three cases here described and found it highly satisfactory.

Technic.—As the figures clearly show, an incision is made through skin and subcutaneous fat above and below the fecal fistula. Then the fecal fistula is circumcised at the mucocutaneous junction and the adjacent intestinal wall is liberated sufficiently to allow of passing a layer of turning-in sutures.[2] These sutures should run transversely to the long axis of the gut so as to increase its lumen at this point. Having closed the opening with this layer of fine plain catgut sutures, two unequal pedunculated flaps (Fig. 2) are fashioned out of the adjacent skin and subcutaneous tissues and so shifted that the broader flap lies over the suture line in the intestine. The narrower flap (half as wide as the broader flap) is then switched around into the denuded area from which the broader flap has been moved. A few skin sutures hold the flaps in their new positions without tension, and a piece of rubber dam introduced just under the lower flap, where approximation is not feasible, serves as drainage.[3] Some sloughing of the tip or of one edge of one of the flaps has usually taken place. Perhaps a better anatomical knowledge of the blood supply in the superficial tissues will help to avoid this in the future. It is also possible that by using a bridge flap attached at both ends, and sliding it into the denudation caused by excision of skin and subcutaneous tissue on the other side of the fistula, one may prevent such slight necroses, which, though undesirable, have not interfered with the object of the whole procedure.

Case I.—M., sixty years of age. Carcinoma of upper part of descending colon.

October 1, 1913: First stage Mikulicz operation. Large tumor and adjacent gut fastened in wound.

October 6, 1913: Second stage Mikulicz operation. Eventrated gut and tumor cut away almost flush with skin. Subsequently, fecal fistula refused to close despite repeated attempts to destroy "spur." After waiting eleven months to determine whether metastases had developed and as there were no signs of such a complication, I determined to close the artificial anus through which most of the fecal current discharged.

September 2, 1914: Closure of fecal fistula under local anæsthesia. The fistulous opening admitted the index finger readily.

[2] The peritoneal cavity should not be opened.

[3] After shifting the flaps two denuded areas remain in that condition on either side of the operative field.

It was packed with gauze to prevent soiling and then the gut was separated from the skin by incising the mucocutaneous junction. Two incisions through the skin and subcutaneous fat were made, extending above and below the fistula two to two and one-half inches. The adherent gut was carefully detached for about one-half inch about the fistula, and the opening was closed by a single layer of turning-in fine catgut sutures transversely to the long axis of the bowel. Then the two skin and subcutaneous fat flaps were dissected up, one having its pedicle above and the other below, and these flaps were switched about so that the larger one covered the suture line in the gut. A few interrupted silk sutures held the flaps in place. Small rubber dam drainage was introduced under lower flap, not, however, reaching to the vicinity of the sutured gut, and a firm dressing applied.

After the operation the patient was placed on opium for the greater part of a week and then his bowels were moved. The flaps healed in satisfactorily. There was a small area of superficial necrosis along the edge of one flap. There was slight leakage from the intestine for a short time and then this ceased and the intestine remained closed, all its contents passing by the normal route.

October, 1914: Discharged cured.

CASE II.—M., twenty-nine years of age. Acute appendicitis, peritonitis. Admitted June 30, 1914. Discharged November 30, 1914.

June 30, 1914: Appendicectomy and drainage for acute gangrenous appendicitis and peritonitis. Shortly after this operation it became evident that the patient had developed an intestinal fistula. As there was rapid loss in weight, and as the adjacent skin was badly irritated, it was determined to sidetrack the intestinal contents from the fistula which appeared to be in the ileum.

September 16, 1914: Ileocolostomy and exclusion of fecal fistula by ligation of ileum; local anæsthesia. The peritoneum was opened through the left rectus muscle, and by means of a rubber catheter passed through the fistula the upper loop was readily identified. Owing to the extensive firm adhesions sufficient ileum could not be mobilized to allow of cutting through the gut and closing both ends and then performing an ileocolostomy. Consequently I performed a lateral ileotransverse-colostomy with sutures and excluded the fistula by tying off the ileum distal to the stoma with heavy silk ligature and infolding the adjacent gut over the furrow thus made.

Experimental work has shown that such an excluding ligature will cut through and nature will reanastomose the gut above and

below within ten days. Consequently, dreading this, on September 19, 1914: Closure of fecal fistula under local anæsthesia was attempted, despite the unhealthy condition of the excoriated skin. The opening in the ileum was fully one and one-quarter inches in diameter. In separating the gut at the mucocutaneous junction, the adherent adjacent loops of intestine were difficult to avoid. Accidentally one such loop was opened and its copious contents spilt into the wound. This was closed with catgut, and then the fistula was closed as in the previous case, transversely to the longitudinal axis of the intestine. Typical flaps were made and shifted so as to cover the accidental opening as well as the fistulous opening in the gut. It was difficult to cover the latter as well as the former with the broader flap.

September 22, 1914: No fecal leakage. Some necrosis of larger flap. Considerable purulent discharge and evident infection of plastic flaps.

October, 1914: Plastic has been successful in so far as there has been no leakage from the accidental opening of the gut.[4] The larger flap has not healed in near its lower edge, and, on lifting it up, one can see the original opening in the ileum. As no evidence of re-anastomosis was apparent, and as the patient was gaining in weight rapidly and all signs of local infection and irritation were disappearing, I determined to wait for some time before attempting a second closure operation. Fifty-two days after the exclusion ligature had been applied there was no sign of re-anastomosis, and, as local and general conditions were favorable, on November 7, 1914: Closure of fistula under local anæsthesia was carried out. In this operation the same steps were performed as at the previous operation. The fistula was circumcised, adjacent area of gut dissected free and then stoma sutured with catgut. The two original plastic flaps (one slightly enlarged) were again lifted and switched back almost into their original positions. The suture line in the bowel was well covered. No leakage occurred after the operation.

November 27, 1914: Patient was discharged completely healed and cured.

Case III.—F., fifty years of age. Luetic stricture of rectum. Patient has been suffering from a tight stricture of the rectum about two to two and one-half inches from the anus. Preliminary to attempting an operation upon the stricture, the patient was placed on antisyphilitic therapy.

February 24, 1915: A sigmoid colostomy was made. As a fair spur had been produced most of the stream was deflected from the

[4] This loop was orad to anastomotic stoma.

rectum and the inflammatory condition above and at the stricture improved.

March 30, 1915: A plastic operation could be performed on the strictured gut. In planning this operation I desired to avoid the fistulæ which so regularly follow resections in the rectum, and to do so applied the same principles as those that underlie the fecal fistula operation described in these pages. Instead of making the usual median incision to expose the rectum, I made a curved incision so as to obtain a large skin and fat flap to lay over the plastic in the rectum and to insure a long circuitous tract from the rectum to the skin, in case the rectal sutures did not hold. The plastic was done on the posterolateral wall of the rectum on the side of the attachment of the pedicle of the skin-fat flap after removal of the coccyx. The plastic consisted of a Y-incision of the rectum which was then sewed up as a V. This brought a good-sized flap of fairly healthy tissue into the strictured ring. Adequate drainage was provided. As was to be expected, there was slight leakage from this suture line in the rectum, but despite this the long fistulous tract below the plastic skin-fat flap closed without any difficulty. As the rectal lumen seemed adequate, admitting as it did the largest rectal bougies, it was decided to close the artificial sigmoid anus.

June 9, 1915: Closure of sigmoid anus under local anæsthesia. As in the previous cases the mucous membrane was separated from the skin and the adherent gut sufficiently liberated without opening the peritoneum, to allow of infolding the stoma with fine catgut. Three or four interrupted infolding sutures were reinforced with a superficial continuous suture, placed as usual, transverse to the long axis of the intestine. This was then covered with the usual skin-fat flaps raised from either side of the fecal fistula. Firm dressing applied. The closure remained complete and though the patient's bowels moved within the first two days, there was no leakage of intestinal contents. The tip end of the narrower flap became superficially necrotic. After separation of the small slough the wound rapidly closed.

The success of this operation has no relation to the available peritoneal surfaces as the peritoneum is not used to insure the closure. Moreover, even the presence of a moderate "spur" does not prevent the success of this procedure (Cases I and III), as the lumen of the intestine is broadened at the site of the fistula not only by using the transverse suture line, but also by the fact that that newly made anterior wall of the gut at the level of the closure is not firm and can give way, covered as it is by fat and skin and no fascia.

Epicrisis.—A careful review of these three cases will convince even the most skeptical that in this comparatively simple procedure, based upon the principle analyzed at the beginning of this paper, a satisfactory method of closing fecal fistulæ of the mucocutaneous type has been developed, and that in this technic a mucocutaneous intestinal fistula can readily be closed without invading the peritoneal cavity and without running the risks usually involved by surgeons in their varied attempts to close those troublesome artificial stomata. The operation is simple, much more simple than the extraperitoneal operations of Smith and Coffey,[5] and apparently most effective.

[5] ANNALS OF SURGERY, June, 1907.

AN ANATOMICAL STUDY OF FEMORAL HERNIA *

TOGETHER WITH A REPORT OF SIX CASES OF INGUINAL HERNIA OF SPECIAL INTEREST THREE WITH PROTRUSION OF THE BLADDER

By T. Turner Thomas, M.D.

of Philadelphia

Interesting herniæ are rather frequent in the surgical service of the Philadelphia General Hospital. All but one of the cases upon which the present report is based were operated on last year during a three months' service and that of Dr. A. C. Wood, to whom I am indebted for the privilege of operating on and reporting the cases admitted to his service. I shall briefly report, first, the inguinal hernia with some important facts concerning bladder hernia, taken from Eggenberger's excellent paper and not generally accessible, and then present a brief anatomical study of femoral hernia.

Case I.—*Inguinal hernia with cystocele.* Man, fifty-eight years, admitted to service of Dr. A. C. Wood February 20, 1914, with a right-sided, direct, inguinal hernia of about two years' duration. Bassini operation the following day. The sac was opened to facilitate the stripping of it from the surrounding tissues, during which there was seen to its inner side, in front of the spermatic cord, and not adherent to the sac, a very thin-walled cystic formation suggesting a hydrocele of the cord. It was not tensely filled and seemed to contain a serous translucent fluid which did not escape during the manipulations until it was opened. When a finger was introduced it passed downward and inward into a larger mucosa-lined cavity which was evidently that of the bladder. The opened hernial sac was then closed by gauze, a part of the bladder diverticulum cut away, and the opening in the bladder closed by catgut sutures which inverted the edges without passing through the mucous membrane. The Bassini operation was completed and a small gauze drain left in the inner angle of the wound down to the bladder sutures. Slight abdominal distention followed but soon passed away and the skin sutures were removed on the eighth day, the small, serum-discharging drainage sinus soon closing.

Case II.—*Inguinal hernia with partially descended testicle and vaginal process closed only at internal ring.* Man, forty-five years, admitted to insane department of Philadelphia Hospital,

* Read before the Philadelphia Academy of Surgery, May 3, 1915.

January 3, 1910, when it was noted that he had a right inguinal hernia. Of late it has been giving him trouble. It is the size of a closed fist, reducible, direct, and the testicle on that side is a little below the external ring. Bassini operation, February 23, 1914. After opening what appeared to be the sac of the hernia it was found to be empty and the finger did not pass into the peritoneal cavity but was stopped at the internal ring. Below the testicle projected into it. Flattened out, its width was about two inches. The hernia was behind it and the hernial sac separated from it by loose areolar tissue. Its unusually large lumen was evidently caused by its being spread out gradually during the growth of the hernia underneath to which it was adherent. We had here a so-called infantile congenital hernia in which one must cut through three layers of peritoneum before reaching the contents of the hernia, the first two being those of the unobliterated vaginal process and the third being that of the hernial sac. This condition is very rare, but a congenital hernia into a completely patulous vaginal process is frequently associated with an undescended testicle. The vaginal process in this case was divided just above the testicle, the upper part removed and the lower part closed above the testicle by catgut suture. The Bassini operation was completed as usual. Recovery was uninterrupted except for some swelling of the scrotum which disappeared later.

CASE III.—*Sliding inguinal hernia.* Man, aged thirty-seven years, admitted to my service July 27, 1914, with a left inguinal hernia about the size of the closed fist, of about ten years' duration. Bassini operation July 31. The sac had a wide communication with the peritoneal cavity and contained a large mass of omentum. A considerable portion of the colon uncovered by peritoneum presented in the lower part of the hernia, a sliding hernia. The lower margin of the sac was cut away to its attachment to the colon, the protruding portion of which was turned into the abdominal cavity by suturing the upper margin of the sac to the posterior, extraperitoneal wall of the colon. Bassini operation completed and recovery uninterrupted.

CASE IV.—*Inguinal hernia with small bladder protrusion.* Man fifty-seven years old, admitted to my service July 27, 1914, with a right direct inguinal hernia, about size of a goose egg. Bassini operation August 3, 1914. The sac was surrounded by much fat. In separating this from the sac on its inner side near the neck the adhesions were firm and their separation started more than the usual bleeding which led to the recognition of a small mass firmer than the fat which covered it. From its position on the inner side of the sac and its consistency it was decided that it could only be bladder, and it was not opened. When the neck of the sac

was closed by a catgut ligature and the rest of the sac removed, the stump with the mass retracted downward and inward under the rectus muscle toward the normal position of the bladder. The chief reason for deciding it to be bladder, however, was a previous experience with Case VI, which had been previously operated on. The Bassini operation was completed, the outer edge of the rectus muscle being also sutured to Poupart's ligament. Uneventful recovery.

CASE V.—*Strangulated inguinal hernia, with early operation.* Man sixty-seven years old, a patient in the department for the insane suffering from senile dementia. Had a large, inguinal hernia on the right side, reducible until the morning of August 21, 1914, when it became painful and irreducible and vomiting set in. Operation the same afternoon. The inguinal tumor was hard, tense, tender, reddened and gave no impulse on coughing. The pulse was rapid and the skin covered by cool perspiration. The evidence seemed to show that there had been no bowel movement for two days. Bassini operation. When the constriction at the neck was relieved and the sac opened, much fluid escaped. The intestinal contents were of a dark red color which returned almost to the normal in about fifteen minutes. The Bassini operation was completed and was followed by an uneventful recovery.

CASE VI.—*Recurrent right inguinal hernia associated with an overlooked bladder protrusion and with a femoral hernia on the same side.* Man sixty-eight years old, admitted to service of Dr. A. C. Wood in the Philadelphia Hospital, March 9, 1914. Had the inguinal hernia 12 years when it was operated on in 1907. It recurred about three years ago. Has a femoral hernia on the same side. Operation March 11, 1914. Inguinal hernia first exposed and much scar tissue encountered in exposing the sac which proved to be that of a direct hernia. The spermatic cord which contained much fat was first freed from its bed with the sac, which was then isolated from the abundant surrounding fat, its neck ligated and the rest removed. The femoral hernia was then exposed after drawing the lower margin of the skin and fascial portion of the incision downward. Its sac was surrounded by and adherent to much fat which was stripped from the sac after opening the latter. After ligation of the neck and cutting the rest away the stump retracted upward under Poupart's ligament into the inguinal region. The stripping of the excessive fat from the sac of the femoral hernia and the removal of only the sac left much fat around and over the femoral vein. In clearing this fat from the pectineus fascia and muscle for the closure of the ring much difficulty was experienced in guarding against a possible wound of the femoral vein which lay under the fat. During this stage

of the operation a hemorrhage was started which proved to be coming from a small opening in the wall of the vein. This was closed by a hæmostat and a lateral ligature applied. The pectineus muscle and fascia were then exposed and approximated to Poupart's ligament by two catgut mattress sutures. Attention was then directed to the inguinal portion of the wound, in the inner part of which was much oozing from what seemed to be a mass of fat. This was ligated in mass and the hemorrhage, apparently, controlled. The Bassini operation was completed, the outer edge of the rectus being brought down with the conjoined tendon by the sutures to the lower edge of Poupart's ligament. The dressings were applied and the patient returned to the ward.

I was still in the hospital an hour later when it was reported that the patient was doing badly. Internal hemorrhage was diagnosed and the patient returned immediately to the operating room. As only the wound in the femoral vein was suspected, only the superficial part of the wound was opened, the suture in the external oblique not being removed. A free exposure of the femoral vein and of the whole wound above and below Poupart's ligament showed no signs of bleeding and the wound was again closed. Intravenous infusion, enteroclysis and other stimulation were given. At noon of the following day, twenty-four hours after operation, only two ounces of urine had been voided. At 6 P.M. of the same day a catheter withdrew only five ounces of urine, which contained a considerable percentage of blood that could not be accounted for. The breath sounds over both lungs were very rough. Forty-eight hours after operation the breathing was dyspnœic, and on auscultation harsh sounds and bubbling râles were heard. The patient died on the same day.

The autopsy showed a large collection of blood extending from the operative wound to the space of Retzius and deeper in the pelvis at the right side of the bladder, some being found in the peritoneal cavity. A ligature was found loosely encompassing a small portion of the top of the bladder on the right side. There was also a large amount of blood in both pleural sacs and blood-stained fluid in the pericardial sac, the origin of which could not be explained.

The reopening of the wound proved that the pelvic hemorrhage did not come from the operative opening in the femoral vein, which was then shown to be securely closed. The only explanation left is that the ligature which was supposed to grasp only a mass of fat encircled a small portion of the bladder which is very vascular, the veins being especially large. This ligature, probably, became loosened at the knot or by the pulling away from its grasp of the small included portion of the bladder, which has a

substantial layer of muscle. This would account, also, for the blood in the urine. At the time of operation I had not thought of the bladder being involved. It was this case which led me to seek further information on bladder hernia and to make an anatomical study of femoral hernia.

Bladder Hernia.—There is a fair probability that the bladder in this case, as well as that in Case IV, had not passed out through the hernial orifice, and, therefore, was not actually a part of the hernia, although it was adherent in both cases to the inner side of the neck of the sac. It was the starting of the hemorrhage during the separation of the firm fatty mass from the inner side of the sac in Case IV, which was operated on subsequently to Case VI, that led to the recognition of the bladder. It suggests that the bladder may frequently be found adherent to the inner side of the sac of a direct inguinal hernia.

One finds little attention given to bladder hernia, aside from the vaginal variety which is not considered here, in our books on surgery even in the large systems, and special studies do not appear frequently in the literature. Eggenberger's paper,[1] published in 1908, reports 5 new cases seen in the previous ten years in Wilm's clinic and 105 new cases reported since Brunner's report of 182 collected cases in 1896. It is a fund of information on the subject upon which I shall draw freely in view of the fact that so little information is generally accessible. In my 3 cases the bladder did not project into the hernial sac but in 2 it was closely adherent to the sac. In only 1 of Eggenberger's 110 cases did the summit of a diverticulum of the bladder entirely covered by peritoneum project into the sac, making it a true bladder hernia. Brunner found 5 in his 182 cases. In 25 of Eggenberger's cases, the hernia was said not to have an associated sac. Of the whole number there were 53 per cent. indirect inguinal, 27 per cent. femoral, 17 per cent. direct inguinal, with 2 in the linea alba and 1 in the perineum. The usual size of the portion of bladder involved is that of a cherry to that of a walnut, rarely being as large as a hen's egg or involving half of the bladder. The ureter has been observed in the hernia. In only one of my cases was the bladder abnormally thin, as far as I could determine, and in that one it was exceedingly thin. Eggenberger says that the diverticulum may have one or two muscle layers or merely the mucous membrane, and its wall be so thin as to be mistaken for the hernia sac, which would apply to my case if it were not for the fluid the diverticulum contained. Notwithstanding this retention the finger later easily passed through its communication with the bladder. In Tedenat's case the diverticulum contained pus

which was not found in the urine, although boric solution was forced into the diverticulum from the bladder. Karewski found the communication so small that after the diverticulum had been opened, fluid could not be forced into it from the bladder.

In the other 2 of my cases the bladder protrusion gave the impression of a mass of fat unusually firm. In the reported cases the herniated portion of the bladder was often surrounded by fat which had to be gone through or removed before the bladder was exposed. Frequently a real lipoma was encountered. Monod and Delageniere as well as Lotheissen considered the prevesical lipoma as a constant sign in bladder hernia. Only in exceptional cases was the absence of the fat expressly noted. The percentage of bladder hernia found in all herniæ operated on varied from 1 to 3 per cent., although Becker in 30 cases found it 26 per cent. Lotheissen said that the number observed depends upon the special attention of the operator and the method of operation, the Bassini operation being especially favorable to their exposure. In one of mine it was discovered by the escape of urine during operation, in one at autopsy, which was responsible for my finding it in the third at operation. All three were found during the Bassini operation. In only 2 of Eggenberger's 110 cases and 18 of Brunner's 182 cases, was the bladder hernia recognized before operation.

Incarceration of the bladder by the hernial orifice sometimes occurs. It does not produce the clinical picture of an intestinal incarceration, although it is similar and easily distinguishable by the colicky pains in the region of the hernia or radiating to the thigh; disturbances of micturition; long continued retention; frequent tenderness over the hernia, and occasionally blood in the urine. Reflex gastric colic and vomiting and other reflex irritative symptoms are not infrequently present. Eggenberger believes that intestinal obstruction is not likely to occur, although in one case there was said to be no stool for eight days and fecal vomiting for four days before operation, while at operation only incarceration of the bladder was found.

Of the 45 of his 110 cases in which the presence of the bladder was first recognized during the operation, and was not wounded, only one is reported to have died. In 39 cases in which the blader was first recognized after being wounded and was then sutured, 3 died. In 9 cases in which the bladder was wounded during operation and overlooked, 4 died. The recognition of the bladder during the operation, therefore, becomes important and is easy enough if its presence is suspected. The failure to separate the sac from the tissues on the

inner side as easily as usual and the presence of a more or less adherent lipoma, should excite suspicion. In palpating the mass one may get the feel of two mucous surfaces moving on each other. In most cases the end of a catheter introduced through the urethra can be made to pass into the diverticulum and can be felt through its walls. If this fails the diverticulum may be distended by boric or other solution injected into the bladder. The color and feel of the bladder, if exposed, as well as its continuation in the direction of the normal bladder, will suffice for diagnosis. The fatty accumulation here should receive attention. If the bladder is unexpectedly opened the escape of urine and even if no urine escapes the passage of a catheter will establish a communication with the bladder. If the cystocele is not wounded during an incomplete separation from the sac, it may be included in the ligature of the sac and a part of the bladder be cut away with the sac. The bladder, during a contracture, may then slip out of the ligature and the opening in the bladder may not be detected.

The diagnosis after operation may be made by the occurrence of hæmaturia or anuria soon after the operation, by a temporary urinary infiltration of the wound and fistula formation, or by the development of peritonitis from the presence of urine in the peritoneal cavity. In two of Eggenberger's cases, a second operation was done in time and the bladder wound sutured. The use of a truss is contra-indicated in all cases in which the presence of a cystocele is recognized, because the hernia is usually irreducible and the truss causes irritation, tenesmus, pain, and leads to inflammation and even gangrene. Small cystoceles found first at operation were repeatedly allowed to remain after being reduced without special treatment. If the bladder has strong adhesions to the sac, it is advisable not to attempt to separate them but to cut away the sac to the bladder, close the sac opening by sutures and reduce the cystocele with the sac. The partly changed bladder wall should restore itself to the normal later. The herniated portion of the bladder may be so thin or friable as to require its excision and closure of the opening by sutures, when a drain should be placed down to the suture line in the bladder. If a secure suture cannot be placed on account of the friability of the bladder wall, the edges of the bladder opening can be sutured to the external wound and drained. If after the operation the urine escapes into the operation wound and not into the peritoneal cavity, a fistula forms and usually closes in three to five weeks. To avoid urinary fistula after bladder suture, a permanent catheter in the urethra is serviceable. In the 39 cases in which the bladder was wounded during operation, the permanent catheter was

employed in 19, a fistula forming in 4. Of the 20 cases in which the permanent catheter was not used, 2 died in consequence of unretentive sutures and 7 developed temporary fistulæ.

Femoral Hernia.—The most essential knowledge of this as of any other hernia concerns its anatomy. But the anatomy of this hernia has been so thoroughly studied and so long established that there would seem to be little profit to be expected from studying it further. Its anatomy, however, was established in the days when operations were rare or not done at all, and was based upon theoretical considerations, chiefly. Except for the femoral ring, which I think is the only important part, the canal is made up of a very weak fascia, and in those cases in which the femoral vein is in close contact with Gimbernat's ligament, there can be no femoral canal. It is the innermost compartment of the femoral sheath and its fascial wall is so thin that it can be traced with difficulty. The only practical purpose it ever served, so far as I can learn, is to explain the peculiar course of a femoral hernia, which is first downward under Poupart's ligament, then forward through the saphenous opening, and then slightly upward. That there is a much simpler and more satisfactory explanation for this course and that the femoral ring is very important and the rest of the canal unimportant, will be one of the chief purposes of my study to show.

To study the anatomy of femoral hernia a formalin hardened body is much better than one prepared in the usual manner, because in the former the structures shown by dissection will better maintain the position they occupied in life. The structures most liable to variation are the femoral vessels, because in life they were filled by a fluid which has largely disappeared after death, especially the vein, because of its larger calibre, more flaccid walls and its adjacency to the site of the femoral hernia which is under study, and is disturbed most by the dissection. In none of the formalin hardened specimens, here illustrated, which are from the department of applied anatomy of the University of Pennsylvania, were the veins distended by injection after death, although the arteries were employed for the injection of the preserving formalin solution. Such collapse of the walls of the vein as did occur disturbed very little its relation to the femoral ring, so that we have in these specimens a fair demonstration of the actual condition of the ring in life and the formation of its boundaries, as well as of some of the variations that may be expected.

Modern illustrations made by skilful artists will best emphasize the features of an anatomical illustration, but they are not convincing when there is doubt concerning the accuracy of the anatomy illus-

trated. The camera would be much more effective if it did not confuse by the mass of unimportant detail and by its failure to bring all parts of the specimen into proper focus. Because of the defects of the camera it will be important to fix attention on the very small part of each illustration under study, the femoral ring or the relation of the femoral vein to the margin of Gimbernat's ligament. A preliminary general study of each illustration will help in making it serve the purpose for which it was intended.

The following reasons for the peculiar course of a femoral hernia have been taken from standard works on surgical anatomy: (1) Slight curve in femoral canal with its concavity forward; (2) narrowing below of the portion of the femoral sheath forming the femoral canal, and the unyielding nature of its adhesion to the lower margin of the saphenous opening and the cribriform fascia; (3) constant flexion of the thigh; (4) traction of the mesentery; (5) the superficial blood-vessels (chiefly veins) and lymphatics descend to the saphenous opening, the veins to join the saphenous vein and the lymphatics to the deeper lymph-nodes, the looping upward tending to suspend a femoral hernia and thus prevent its further progress downward. Let us consider these reasons, briefly, in order. (1) The canal is said to be only a half to three-quarters of an inch long, so that it cannot have much of a curve. (2) The fascial wall of the canal is so thin and weak that it can be found only with difficulty. Regardless of any adhesions it may have, it can offer little or no resistance to the progress of the hernia. (3) Flexion of the thigh should push an inguinal hernia forward and upward if it does so with a femoral. (4) Traction of the mesentery should be no greater than in an inguinal hernia which frequently descends to the bottom of the normal scrotum and sometimes much lower. (5) The blood-vessels referred to (superficial epigastrics) lie external to the course of a femoral hernia and cannot obstruct it, while the lymphatics are so small as hardly to be worth considering. The following explanation, in my opinion, is much more simple and satisfactory and will be best illustrated by the left side of the body shown in Fig. 2. The model illustrated in Fig. 3 will also be of service.

As soon as they pass through the femoral ring, with its three unyielding sides, the hernial contents immediately re-expand. This expansion takes place in all directions except backward, in which direction it cannot expand because immediately behind the hernia is the pectineus muscle resting directly on the pubic bone (see Figs. 4 and 5). Only the skin and weak fascia resist anteriorly so that the whole antero-posterior expansion is forward, and the central axis, therefore, curves

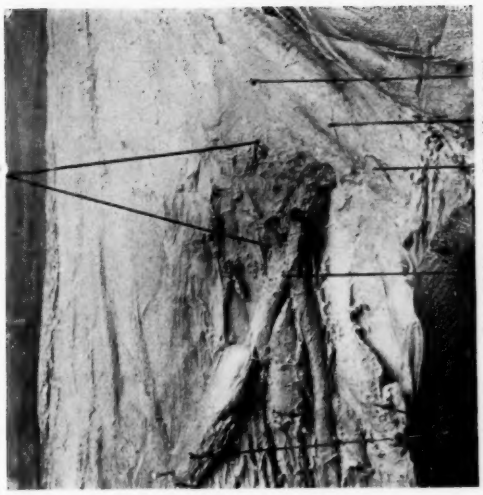

FIG. 1.—Right groin. Skin and superficial fascia removed. Fascia lata fuses with Poupart's ligament and becomes thin (cribriform fascia) where perforated by saphenous vein. Saphenous opening must be made by dissector's knife or scissors. Lymph-nodes which covered cribriform fascia have been deflected.

FIG. 2.—Regions of inguinal and femoral herniæ on both sides of body. On right side fascia lata exposed with removal of cribriform fascia, making saphenous opening. Lymph-node resting against femoral ring, but not passing through it as shown in Fig. 10. Portion of external oblique muscle turned inward, leaving Poupart's ligament, internal oblique and spermatic cord in normal positions. On left side fascia lata removed, exposing Scarpa's triangle with its contained structures in normal position. Only Gimbernat's ligament has been touched by paint brush to emphasize absence of any space between it and femoral vein.

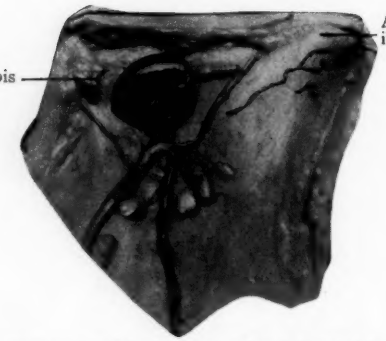

FIG. 3.—Taken from a museum model of a strangulated femoral hernia in the University of Pennsylvania. The small size of the hernia, the single loop of intestine and the turning forward of the hernia are characteristic. The turning upward is, probably, exaggerated. The color of the intestine indicates strangulation.

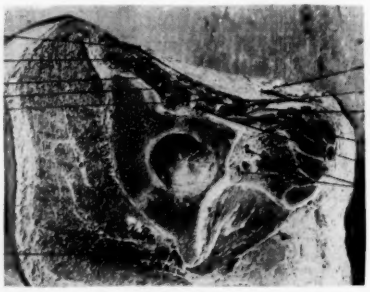

FIG. 4.—Cross-section of thigh at its junction with abdomen, a little above outer half of Poupart's ligament. Femoral ring unusually large, partly because of small femoral vein. Space between Poupart's ligament and pubic bone almost entirely filled by iliacus and psoas muscles with anterior crural nerve between the two. Boundaries of femoral ring shown clearly. Pectineus muscle seen under ring when viewed externally, but not when looked at from inside (see Fig. 8) because the pectineus ends above at the margin of the ring.

FIG. 5.—Cross-section of thigh at its junction with abdomen, as in Fig. 4. Inner portion of thigh cut longitudinally to save the penis and scrotum. Femoral vein larger than in Fig. 4 and in intimate contact with margin of Gimbernat's ligament, so that in such a patient no femoral ring exists until a hernia comes through and pushes the vein outward.

FIG. 6.—Case VII. An unusually large femoral hernia. It clearly does not turn upward, although in its upper part it overlaps Poupart's ligament. The darkened area of skin over the most prominent portion was very thin and became the apex of a conical tumor when the patient coughed.

FIG. 7.—Case VII. More clearly shows that most of the hernia is below Poupart's ligament

FIG. 8.—View from inside of specimen shown in Fig. 4. Lower boundary of femoral ring now seen to be the pubic bone. Wall of the small femoral vein seems to have fallen away slightly, enlarging the ring still more.

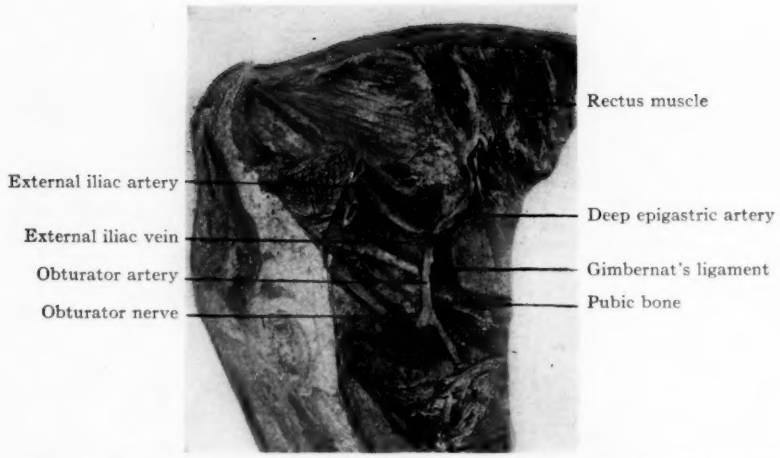

FIG. 9.—Inside view of left half of specimen shown in Fig. 2. Absence of femoral ring again shown by close contact of femoral vein with Gimbernat's ligament. It was particularly difficult to obtain a satisfactory picture of this specimen from the inside. This side has been emphasized slightly by the artist.

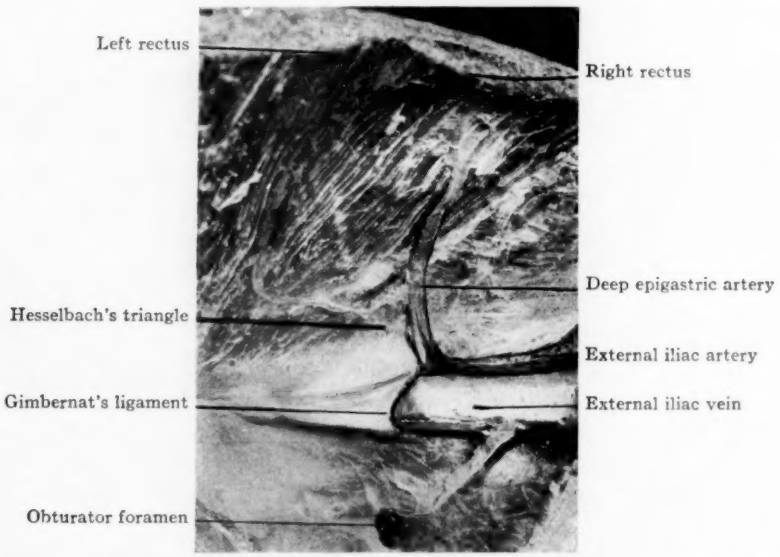

FIG. 10.—Inside view of right half of specimen shown in Fig. 2. Margins of the vessels and Gimbernat's ligament emphasized slightly by the artist. No actual femoral ring here and lymph-node seen on this side in external view (Fig. 2) not seen on inside.

FIG. 11.—Left half of male pelvis looked at from right side and posteriorly. Rest of picture sacrificed to focus attention on femoral ring. Bladder in this specimen rises more than an inch above the top of the symphysis pubis. Normally it is at or below this level. It is also seen to extend close to the femoral ring and inguinal canal, the inner end of which is just above the femoral ring, so that the bladder might find its way into a femoral or a direct inguinal hernia.

FIG. 12.—Right half of same pelvis shown in Fig. 11. Femoral ring filled and perhaps effectively plugged by a lymph-node. Enlarged bladder again evident. Abnormal fold in abdominal wall above due to bending it forward.

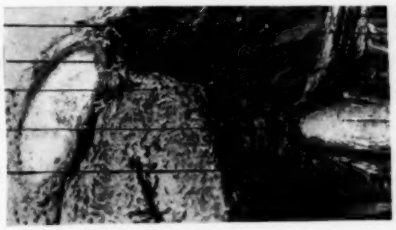

FIG. 13.—Right half of pelvis showing femoral ring covered over by the obturator artery and vein which are coming from the deep epigastrics. These might effectively prevent the development of a femoral hernia. On lifting these vessels and exposing the femoral ring, the margin of Gimbernat's ligament was found separated from the vein about a quarter of an inch. Much thickened bladder, probably due to its complete collapse.

forward. I believe that this central axis does not curve upward, but that the expanding mass simply overlaps Poupart's ligament above (see Figs. 6 and 7), because the narrow neck is just below Poupart's ligament and is curving forward. The intestinal loop in Fig. 3 does curve upward, but we should bear in mind that this represents only a model made to show what some surgeon wanted it to show. Such an intestinal femoral hernia without accompanying omentum is probably uncommon. Rarely the hernia will force its way backward slightly by separating the fibres of the pectineus muscle (see Figs. 2, 4 and 5). This is known as the hernia of Cloquet. Very rarely the hernia escapes outside of the femoral vessels and then is usually also in front of them. Still more rarely it may come down behind the vessels.

The small size and infrequency of the femoral as compared with the inguinal hernia, in all probability is due to the small space through which it must escape from the abdomen and the unyielding margins of this space on three sides. It is a little difficult to understand why the femoral vein does not suffer more from the pressure of the hernial neck with swelling of that limb, as it is on the only side of the neck which can yield much to the pressure. It is likely that it is aided by the attachments of its fascial sheath to Poupart's ligament above and the pubic bone below in accommodating itself to its crowded condition. The size and character of the opening have an important bearing, also, on the nature of the hernial contents. Not infrequently, writers refer to the contents as though they were usually omentum and intestine or one was present as frequently as the other, Da Costa,[2] however, says that femoral hernia contains omentum, but rarely intestine, except in strangulated cases. My study of femoral hernia seems to support this statement, and leads me to regard it as a particularly dangerous hernia because at any time intestine may escape and cause strangulation. The ring may be unusually large, as in Fig. 4, and the intestine escape strangulation. Thomson and Miles[3] say that the hernia is often as small as a cherry or a pigeon's egg and may contain only a small tag of omentum or a portion of the circumference of the bowel—Littre's hernia. Large herniæ containing several coils of intestine are sometimes met with. In my group of cases intestine was not present when the sac was opened in any, except the two which were strangulated, and in both of these a small single loop was surrounded by a much larger mass of omentum. This suggests that both were purely omental until the escape of intestine caused the strangulation. The probability is that in most cases, as soon as the wall of the intestine gets into the ring its circulation is dangerously restricted by the pressure and that

strangulation is present either before the whole circumference of the bowel can escape or soon afterward, so that more than a single coil is rarely met with. The surgeon knows how difficult it is, frequently, to prevent the escape of very small portions of the omentum between the stitches while closing the peritoneal layer of an abdominal incision. He, therefore, knows that omentum can escape through a very small opening and may not suffer much from the constriction. But all of the omentum would not make a very large hernia, and all of it could not escape without taking with it the transverse colon. In a recent case of strangulated inguinal hernia upon which I operated, the length of the hernia was about equal to two closed fists side by side and the diameter slightly larger than that of the fist; the contents consisted of almost all of the omentum and a considerable portion of the transverse colon. The mass of extruded omentum was about the size of that of the colon. Very large herniæ are, therefore, made up chiefly of intestine, and a femoral hernia usually remains small because only omentum in varying quantity can come through or the early constriction and strangulation of the first loop of intestine prevents more from escaping. This is particularly true because the neck of the hernia is usually already filled with omentum before the intestine comes through.

Akerman,[4] in 1889, reported 235 cases of gangrenous intestinal hernia operated on in the Swedish Hospitals; and in 1913, 664 new cases, making a total of 899 cases. Of these, 214 were inguinal, 658 femoral, 13 umbilical, 7 ventral and 7 obturator. The femoral were slightly more than three times as frequent as the inguinal and the proportions of all kinds varied very little in the two groups of cases, which contributes to the reliability of the proportions since they are made up from cases operated on at different hospitals and by different surgeons. Von Bergmann and Bull [5] quote the following authorities on proportions of inguinal to femoral, in strangulated herniæ: Bryant, 50 to 44; Gosselin, 113 to 104; Maydl, 159 to 132; Henggeler, 111 to 159. Deaver and Ross [6] recently gave them as 77 to 50. The total number of cases in this group is 999, or 510 inguinal and 489 femoral. But Akerman reported only cases in which gangrenous intestine was found, while this group includes all strangulated herniæ. A pure omental femoral hernia may become strangulated but this is probably rare. One in an elderly hemiplegic woman came to autopsy at the Philadelphia Hospital recently. Many strangulated herniæ are now operated on before gangrene sets in but, owing to the smaller space and sharp, rigid margin of Gimbernat's ligament, gangrenous intestine may be expected earlier and more frequently in femoral than in inguinal hernia. Coley [7] says that of

75,535 cases of hernia admitted to the New York Hospital for Ruptured and Crippled Children, the relative frequency of femoral to inguinal was about as 1 to 17, which he says is the same proportion as that observed at the London Truss Society, according to the statistics of Macready. In 1720 operations for hernia, Sertoli [8] found 106 femoral and 1543 inguinal, or a proportion of 1 to 15. If we estimate strangulation in femoral as almost as frequent as in inguinal and the general proportion of inguinal as 15 to 17 times greater than femoral, the chances of strangulation are correspondingly greater in femoral. Intestine is very frequently present in inguinal hernia, and DaCosta's observation that it is rarely present in femoral, except in strangulated cases, is probably correct. If all inguinal herniæ are 15 to 17 times more frequent than all femoral, intestine very frequently present in inguinal and rarely in femoral, and strangulated femoral almost as common as strangulated inguinal, then intestine escaping into a femoral hernia will rarely escape strangulation.

There were said to be 116 Littre's herniæ in Akerman's second group of 664 gangrenous intestinal herniæ (154 inguinal and 487 femoral), but his report does not show their relative frequency among the different varieties of hernia. A Littre's hernia is one in which only a part of the circumference of the bowel escapes, *i.e.*, in Akerman's cases, strangulation occurred before the whole circumference of the bowel could get through the constricting ring. The presence of a small single loop is characteristic of a strangulated femoral hernia because of the small space through which it must pass and the rigid and sharp margins of the ring, as shown by the illustrations. Strangulation is more frequent, relatively, in obturator hernia because the obturator ring has still more rigid margins and is not capable of being enlarged as much as the femoral ring. These facts support the suggestion that intestine will rarely escape through the femoral ring without becoming strangulated, and that, therefore, all femoral herniæ are dangerous because intestine may escape on any severe strain. When the femoral ring is large, as in Fig. 4, there may be little danger of constriction, but such large rings are probably the exception and not the rule.

The diagnosis of a femoral from an inguinal hernia is sometimes difficult. In four of this group inguinal hernia had been diagnosed. Some years ago a group of young surgeons debated the diagnosis in the case of a boy. It was finally decided that it was probably an inguinal hernia. I had the privilege of operating on this case and it proved to be a femoral. The tendency has seemed to be to diagnose inguinal, when

in doubt, because, owing to the greater frequency of inguinal, the chances are in its favor. According to my experience, if the diagnosis is difficult the hernia is likely to prove to be a femoral. It is more easy to demonstrate that an inguinal hernia is above Poupart's ligament than that a femoral hernia is below, because the latter pushes forward immediately below the ligament and its upward expansion covers and obscures it (see Figs. 6 and 7), while an inguinal hernia makes the ligament rather more distinct than normal. In the male, the external inguinal ring can be felt by invaginating the scrotum, in the absence of a hernia, and when it has been enlarged by a hernia it is more easily recognized. Examination of this ring is a valuable aid in determining if the hernia is inguinal or not. But it is much less easy to feel the external ring in a female in whom femoral hernia is much more frequent, and it is not easy to feel the margins of the femoral ring when a hernia has been reduced through it, especially if the patient is fat, as many of them are. When there is little fat it is not difficult to recognize that the tip of the finger sinks into an abnormal depression, at the site of the femoral ring, just below Poupart's ligament and well outside of the spine of the pubis. When there is much fat, the patient a female, the hernia irreducible, and the external inguinal ring cannot be felt, it may be very difficult to positively diagnose a femoral hernia. During the past fifteen years, it has been my privilege to examine a large number of hernia, especially at the Philadelphia Hospital, and this experience has taught me that it is best, when the diagnosis is doubtful, to regard the hernia as femoral until I can prove that it is not. The best evidence in favor of its being femoral is that most of the tumor lies below the approximate line of Poupart's ligament (an inguinal is distinctly above), that it is well outside of the pubic spine (the spine can be felt outside of an inguinal hernia), and when the hernia is reduced the finger can usually be pressed into a depression just below Poupart's ligament.

The great danger to which hernia patients are exposed is that of strangulation, and the risk is greater in femoral than in any of the other common forms. Obturator hernia is comparatively more frequently strangulated than femoral but is not as common a hernia. So long as a femoral contains only omentum there is probably little danger of strangulation, but a knuckle of gut may escape at any time and bring on strangulation. Akerman discussed, chiefly, the results of operation for gangrenous intestinal hernia which were bad, v. Bergmann [9] says that there is little reason to expect a favorable result from taxis in strangulated femoral hernia and that one should advise

against it and in favor of radical operation. Since the patient is always in danger of the escape of intestine and the development of strangulation, the best treatment is to prevent gangrenous hernia by operating before strangulation occurs. Operation in this stage has a very low mortality and recurrence of the hernia is rare. Many different operations have been performed in comparatively recent years. Ochsner [10] enumerated 20 and Sprengel [11] (quoting Goebel) 50. The plastic operations for filling the canal by muscular, periosteal, osteoperiosteal and heteroplastic flaps are wrong in principle, in my opinion, and have had little support, while the simpler operations prevail. Ochsner says that removal of the sac without closure of the canal will cure all cases. While I added one or two mattress sutures to close the ring, I found much in my anatomical study to support Ochsner's radical statement. With proper regard for the femoral vein the operation becomes almost a minor one. The hernia is almost subcutaneous, no muscles are divided and the peritoneal cavity is barely opened. The placing of one or two mattress sutures to approximate Poupart's ligament to the pectineus muscle and fascia adds little or nothing to the danger of the operation, the early performance of which in practically all cases would involve much less risk than taking the chances of intestine or bladder escaping through the ring and causing strangulation.

If the sac is separated from the margins of the ring on all sides, drawn down and the ligature placed as high as possible, the stump will retract or can be pushed upward into the abdomen, when nothing will intervene between the femoral vein and the remaining margins of the ring. The anatomical illustrations show that the femoral vein must have been pushed outward by the hernia away from the curving margin of Gimbernat's ligament. When the hernia has been entirely removed the femoral vein relieved of this pressure should soon find its way back to its normal position, close to or in contact with the margin of Gimbernat's ligament. The vigorous contractions of the very active iliacus and psoas muscles should be important factors in forcing the vein against the ligament, since they almost completely fill the space between Poupart's ligament and the underlying pubic bone (see Figs. 4 and 5). The effect of sutures forcing Poupart's ligament down to the pectineus muscle would be to compress the vein and thus force it into closer contact with the remaining margins of the ring. The introduction of tissue of any kind, as bone, muscle, etc., into the ring would not close it more effectively but would only serve to permanently displace the vein from its normal position. Cicatricial adhesion of the vein to the remainder margins of the ring would be more effective in pre-

venting a recurrence of the hernia, since it is just this relation which best prevents the first development of the hernia. A purse-string suture would accomplish the same purpose as the mattress sutures but has no advantages over them.

The usual method of exposing the sac, separating it from the surrounding fat, and after ligating its neck cutting it away, leaves the ring and the femoral vein covered by a confusing mass of fat which is retracted with some difficulty and makes the exposure of the pectineus muscle and fascia and protection of the vein rather troublesome. The normal fat of this region is considerably increased by the preperitoneal fat pushed out with the sac and left here after the sac has been removed. I have found it advantageous to remove a thick layer of fat with the sac, so that the later exposure of the margins of the ring, femoral vein and pectineus muscle becomes less troublesome. In my opinion, the vertical has advantages over the transverse incision. In its upper part the external oblique aponeurosis is quickly exposed and its lower border, Poupart's ligament, easily outlined. This is an excellent landmark. Just below it the neck of the sac with its surrounding fat can be seen, just external to which is the femoral vein. Removal of the adherent fat with the sac, high ligation of the neck with retraction upward of the stump out of the operative field, will facilitate the protection of the femoral vein and the passing of one or two mattress sutures to approximate the pectineus muscle and Poupart's ligament or the floor and roof of the ring.

Having had no experience with the method of closing the ring from the inside, through the inguinal canal, I can express an opinion based only upon my anatomical study and my experience with the ordinary closure of the ring from the outside. The illustrations showing the ring from the inside (see Figs. 8, 9, 10, 11, 12 and 13) demonstrate that its lower boundary is the pubic bone. This is covered only by loose connective tissue and peritoneum. In exposing the ring for the placing of the sutures, most of the overlying connective tissue is pushed away, leaving only the periosteum and a little connective tissue to hold the sutures. I would not trust the needle to pass under the periosteum without cutting its way out, in which case the suture could have no influence in closing the ring. On the other hand, the obturator vessels not infrequently come from the deep epigastric and pass to the obturator canal over the internal surface of the ring, as shown in Fig. 13. In most other cases pubic branches of the deep epigastric of considerable size have the same general relation to the ring as they pass to the pubic region. There are no such vessels to interfere

with the exposure and suture of the ring from the outside, where the suture can take hold of the substantial pectineus muscle and overlying fascia forming the floor of the ring. This muscle arises at the bony margin of the ring so that the suture catches it immediately below the ring. The advantage, therefore, should be with the external operation.

Case VII.—Man, forty-four years old. Admitted to tuberculous wards of Philadelphia Hospital, December 6, 1913. Diagnosis of advanced tuberculosis of lungs and tuberculosis of intestines. Now has a hernia in the left groin. Says he was operated on in this hospital for a hernia on the left side during the past summer, and this is confirmed by the presence of a linear scar over the position of the inguinal canal. It was, therefore, assumed that we were dealing with an inguinal hernia recurring after operation and no further effort was made to establish the diagnosis. Transferred to surgical service of Dr. A. C. Wood, January 10, 1914. The size and shape of the hernia are shown in Figs. 6 and 7. During standing and coughing, which is severe, the hernia assumes a conical shape and the skin over the most prominent part is bluish in color and evidently very thin. The patient desires operation because, during coughing, he has the feeling that the hernia is about to burst, and it then looks as though it might do so.

Operation (January 12).—Under spinal anæsthesia, with 10 c.c. of a ½ per cent. novocaine solution. The incision was made to expose an inguinal hernia. The skin was very thin over the most prominent portion of the hernia and was here very adherent to the sac. The external oblique and external ring appeared to be normal, no evidence of a scar of a previous operation being found in this muscle. The neck of the sac was found to be coming through the femoral ring. It afterward developed that he had been operated on for an abscess of the groin and no record of a previous operation for hernia could be found. The only contents of the sac found at operation was omentum, although my recollection of the way in which the hernia distended during coughing and its size led me to believe that it then contained intestine also. The neck of the sac was isolated as high as possible, drawn down and ligated as high as possible, and after removal of the sac the stump retracted upward. Two catgut mattress sutures were employed to approximate Poupart's ligament to the pectineus fascia and muscle in order to close the probably large ring. Silkworm-gut sutures for the skin. Dressing. Primary healing. Firm pressure was maintained over the wound by adhesive strips and a spica bandage of the groin for five weeks. Notwithstand-

ing the continuous severe coughing no recurrence of the hernia had occurred up to the time of his death on December 9, 1914.

CASE VIII.—Woman, forty-six years old, well nourished. Transferred to my service in the Philadelphia Hospital, July 4, 1914, from the nervous ward where a cervical myelitis was diagnosed. On the right side, just below Poupart's ligament, is a hernia about the size of a hen's egg, which is easily reducible and had been diagnosed as an inguinal hernia. The patient has been and is now complaining of much pain in the abdomen, particularly in the pelvic region. A dilatation and curettement of the uterus had been done for the possible relief of the pelvic pain.

Operation (July 10).—The patient requested that her abdomen be opened on account of her pain. Trendelenberg position. Pfannenstiel incision just above the pubis, and the abdomen opened and explored, but nothing abnormal found that would account for the abdominal pain. Abdominal wound then closed up to and including anterior sheath of the rectus muscle. Right end of skin and fascial portion of incision lengthened to region of hernia, the neck of which was easily outlined just below Poupart's ligament. The sac with its adherent fat was separated from the surrounding tissue, opened and found to contain some adherent omentum which was drawn down and ligated high and cut away beyond the ligature, the stump retracting upward into the abdomen. Poupart's ligament sutured to the pectineus muscle and fascia as in the preceding cases, and the skin incision closed with silkworm gut. Uneventful recovery and no recurrence of the hernia up to the present time.

CASE IX.—Man, fifty years old, laborer. Admitted to my service in the Philadelphia Hospital, July 30, 1914, with a hernia in the left groin about the size a small fist, which is reducible. Femoral hernia diagnosed and operated on July 31.

Operation.—Vertical incision over hernia, exposure of external oblique first and neck of hernia just below Poupart's ligament. Sac with adherent fat isolated, ligated high and removed as in preceding cases, and Poupart's ligament sutured to pectineus muscle and fascia. Silkworm gut for skin wound. Uneventful recovery and no recurrence up to present time.

CASE X.—Woman, sixty-nine years old. Emaciation and wrinkling of face make her appear ten years older. Admitted to my service, July 5, 1914, with a strangulated femoral hernia on the left side, and in a stuporous condition. From a relative it was learned that the hernia had existed about four years. For about four days before admission it had been irreducible and painful and after admission mild attempts at reduction by the

interne were unsuccessful. Operation the same day under local anæsthesia with a 2 per cent. novocaine solution.

Operation.—Sac exposed by an incision parallel to Poupart's ligament, opened and found to contain a considerable mass of omentum and a single loop of small intestine about four inches long. Both omentum and intestine were dark in color but neither was completely gangrenous, the intestine being a dark red. Gimbernat's ligament was divided on a grooved director and the loop of intestine drawn out until healthy bowel was reached. In doing this the inner limb of the loop gave way into the lumen at what was clearly the line of constriction by the sharp edge of Gimbernat's ligament and where the bowel wall was distinctly necrotic. The omentum was also driven out until a healthy portion was reached and it and the intestine were sutured to the margin of the ring. A portion of the omentum was removed, but the intestine was not resected because of the very weak condition of the patient. The bowels were freely opened, but no fæces appeared until the following day, when they escaped freely. The patient showed no signs of reaction after the operation and died two days later.

Case XI.—Woman, fifty-seven years old. Admitted to my service in the Philadelphia Hospital, August 7, 1914, with an irreducible right femoral hernia, which extended about six inches in the line of the groin and about two inches from above downward. The patient is dull and semistuporous and her statements are hardly reliable. The only apparently reliable answers she gave seemed to show that the hernia became irreducible about two weeks ago, that the bowels have not moved in that time and that she has not vomited. The overlying skin is dark red in color and the hernia tense and very tender. It is irreducible, there is no impulse on coughing and there is fluctuation in one part. Diagnosis of a strangulated femoral hernia was made. The patient is fairly well nourished, but there is a purulent discharge from both eyes and the left nostril. Heart and lungs negative, abdomen much distended, and a small umbilical hernia which is apparently giving no trouble. Operation soon after admission under local anæsthesia with a 2 per cent. novocaine solution.

Operation.—Incision in long axis of hernia. As soon as skin and subcutaneous tissue were divided, a small quantity of dark, grumous, foul-smelling material was evacuated. The sac was thick and dark in color and when opened was found to contain a considerable mass of omentum and a small single loop of small intestine, both of which were distinctly gangrenous. Gimbernat's ligament was carefully divided on a grooved director and the intestine and omentum brought out until healthy portions of

both could be sutured to the margins of the ring. A portion of the protruding omentum was cut away. The line of demarcation in the intestine was distinct. On the following day the gangrenous portion of the bowel was cut away and soon afterward fæces appeared in the wound. The patient did not react from her weak and semistuporous condition, although she lived for three days after the operation.

CASE XII.—Medical student, twenty-four years old. While playing foot-ball about ten years ago, developed a severe pain in the right groin. A direct inguinal hernia was diagnosed at the time and at different examinations afterwards. I saw him July 6, 1914, and diagnosed a femoral hernia which was found at operation, two days later, at St. Agnes Hospital.

Operation.—A longitudinal incision about 2½ inches long was made over the hernia, the sac exposed and opened but the neck was so small that a finger could not be passed through the ring, a grooved director being necessary for the purpose. The sac with its adherent fat was isolated, drawn down, ligated high and cut away, the stump retracting upward under Poupart's ligament. The pectineus muscle covered by its fascia was exposed and Poupart's ligament drawn down to it by one catgut mattress suture. Silkworm gut for the skin and dressing applied. Healing uneventful. He has since engaged in vigorous exercises without any sign of recurrence of the hernia.

Conclusions on Femoral Hernia.—In femoral hernia we are concerned not with a canal as in inguinal hernia, but with a ring as in umbilical hernia.

The femoral hernia turns forward immediately after passing under Poupart's ligament, because it can expand only forward, the pectineus muscle lying on the pubic bone preventing any backward expansion. The upward expansion of the hernia overlaps and conceals Poupart's ligament, but the whole hernia does not turn upward. Occasionally it separates the fibres of the pectineus, posteriorly, and is then called a hernia of Cloquet.

A femoral hernia is usually small and comparatively infrequent, for the same reason that an obturator hernia is small and infrequent, because of the small ring and its rigid margins. The femoral ring is small or does not exist until the escaping hernia pushes the femoral vein away from the margin of Poupart's ligament, which it does with difficulty and for a small distance. Omentum gets through with difficulty and intestine is usually strangulated soon after it begins to come through. Most femoral herniæ are, therefore, omental until intestine escapes and causes strangulation.

When the diagnosis between inguinal and femoral hernia is difficult, a femoral hernia will probably be present.

All femoral herniæ should be considered dangerous because intestine may escape on any severe strain and cause strangulation. For this reason it is safer to operate on all femoral herniæ before strangulation than to take the chances of strangulation.

The hernia is subcutaneous, no muscles are divided, and the peritoneal cavity is barely opened. Simple removal of the sac will probably cure in the great majority of cases, but the approximation of Poupart's ligament to the pectineal muscle and fascia by one or two catgut sutures will add to the certainty of cure.

The vertical has advantages over the transverse incision, and the removal of a thick layer of the fat adherent to the sac favors the easier exposure and suture of the ring.

The closure of the ring by the external exposure and suture is safer, easier and more effective than by the internal exposure through the inguinal canal.

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THE CLINICAL STATUS OF THE AUTOGRAFT*

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The growing literature on autogenous transplants reflects the interest of the profession in this phase of the most recent development of modern surgery. Notwithstanding the recent exploitation of this procedure, there are descriptions of pedicled autogenous transplantations antedating the Christian era, for instance, the Indian method of rhinoplasty where the tissues of the forehead were swung down to form the new nose.

As in the evolution of every science, art or craft definite lines of procedure or technic gradually crystallize out of the mass of experimentation. So, in surgery, at the present time, we have new operative methods; the result of clinical evolution, which has established accepted operative procedures, which now take their place alongside the classical operations, and by these procedures we build up or repair defects or injury of one tissue by utilizing the same tissue taken from a point remote from the lesion, or by tissue of other histological form.

The profession is unanimous that alien or heteroplastic transplantations are never successful: the differing serological and cytological relations between the differing animals precludes the survival of such transplants. There is not, however, such unanimity with regard to homotransplants, many observers reporting successful results from homografts of bone, fascia, skin, blood-vessels, joints, thyroid tissue, parathyroids, ovaries, etc. Yet there are dissenters, who believe the ultimate survival of the homograft, as such, is rare; probably these different views are due to the different perspectives of the clinicians and the pathologists, for what may be successful clinically may not so prove to be to the microscopist.

Even heteroplasty [redacted]ean field may simulate a clinical success, for although the graft is absorbed or encapsulated, or the tissues of the host gradually replace it, a funct[redacted]esult may occur, hence the seeming confusion. Unquestionab[redacted]me of the simpler transplants from humans or animals of the same species which are closely related or whose fluids and tissues are much alike may survive, while in other instances where dissimilarity exists, they will succumb. Parallel ob-

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servations have been made upon the blood of two individuals, one being hæmolytic for the other.

The ideal condition for transplantation exists only when the graft is an autograft. Here the nourishing pabulum is the same for all of the tissues and an adaptation is unnecessary. The histology of the transplanted tissue has much to do with the success or failure of the transplant. The more complex or highly specialized the cells, the less are their chances for survival, for example, nerves, muscles, or parenchymatous cells, while the simpler tissues retain their vitality, such as fat, fascia and tendons.

The growth of tissue *in vitro* has borne out the clinical observation that the simpler tissues receiving their temporary nutrition by osmosis from the plasma can survive until their blood supply is re-established, while the more complex tissues need an immediate blood supply to support life. Assuming that the vascularization of a tissue is adequate, it must needs have work to do or special functions to perform if it is to survive and proliferate. This law is well emphasized in the growth of weight-sustaining bone to the needs of the limb and in the functional activity (for a time at least) of thyroid tissue in the presence of hypothyroidism.

An aseptic field and sterile plasma as a culture medium for a transplant, is necessary for successful transplantation, although bone and fascial grafts have shown rather a marked resistance to sepsis. Blood-clotting about a graft is a serious mechanical interference with the nutritive lymph reaching the graft, therefore absolute hæmostasis is imperative. An exacting technic which forbids the contacting of the gloved fingers with the wound, transplant, or instruments touching the operative field, and a minimum of instrumental contact with either, must be insisted upon, as only by such exaggerated care can success be obtained.

Early reports by Lexer and Tuffier of complete joint transplantations, where refrigerated joints of cadavers or amputated limbs were used, aroused the hope of the profession that this method would offer brilliant results. [redacted] cases of elbow transplants were said by Tuffier to be satisfactory [redacted] the expiration of eighteen months. No later reports relative to them have been noted. Lexer describes one case of knee transplantation six years after operation. He says the joint was in no way normal and in appearance simulated that of arthritis deformans, also that the result was in reality that of pseudo-arthrosis. In autoplasty, Buchman has reported transplanting the great toe joint into the elbow with fair results, while several surgeons have substituted

the patient's own toe-joints for his finger articulations; therefore, in view of the discouraging reports by the men who advocated joint transplantations, to most surgeons, arthroplasty offers much the greater attraction, both as to simplicity of technic, availability of tissues and ultimate success.

The transplantation of bone which is clinically yielding such very brilliant results in the hands of nearly all surgeons, brings up the interesting problem now being debated with animation, namely, the question of the viability and regeneration of the graft.

Dominating the many attractive theories are those advanced by Axhausen, Macewen and Murphy. The former affirms that the periosteum alone survives and regenerates bone; the second, teaching that the bone itself is osteogenetic, the periosteum acting simply as a limiting membrane to the osteoblasts; while the third believes that the graft or its periosteum has naught of inherent osteogenesis and retains only the faculty of osteoconductivity when contacting at one or both ends with living bone.

A vast amount of experimentation has been done, much of which has served but to befog the question, as the results of one group of observers do not confirm those of another: one man is able to grow bone from free periosteum transplanted into the soft tissue, while another is not. In our own laboratories, Corbett has grown bone from free transplantation of periosteum of young animals only, never from adult periosteum. He has noted that bone and periosteum implanted into the abdominal region of rabbits has survived for two years, only to be then absorbed. We have yet to determine whether or not this bone would have survived indefinitely, if, according to the law of Roux, it had been given specific work to do.

To us there is something of truth in all of the theories as presented by Axhausen, Macewen and Murphy, probably a part at least of each of their theories is exemplified by the life cycle of a periosteal, endosteal and bone graft, for, after all, life, death or regeneration is entirely dependent upon the one need of vascularization.

Numerous observers have shown that small grafts with or without periosteum, offering a relatively large surface to the nutritive plasma will survive. They have also shown that 41 per cent. of the large grafts without periosteum lived, while 100 per cent. of the grafts with periosteum were viable. If the periosteum and endosteum offer greater facilities for vascularization, wherever possible, they should be utilized; although in several of our earlier grafts we had perfect clinical results without them. We believe that part of the cortex of the bone adjacent

to the periosteum and the endosteum, receiving early, through these membranes, its nutrition from the lymph, may survive, while the deeper-seated bone, failing of nutrition, dies and is absorbed, only to be later regenerated from the inner layer of the periosteum with possibly the aid of osteoblasts derived from the contacting living bone.

In two of our cases where bone was transplanted into an old infected field, the grafts survived, probably due to an established immunity. Lewis and others are deliberately transplanting autografts into cases of osteomyelitis with encouraging success. These results are certainly suggestive of an inherent osteogenesis. Suggestive of this as well are the reported facts of repair of fractured bone grafts with callus formation at the point of fracture; also of the sequestration and involucrum formation from a free bone graft in the presence of infection.

The many uses of bone grafts have been so freely detailed that we wish to speak of but one. If the bone transplant is exhibited for the repair of a non-united fracture, two methods of use are available—the inlay or the intermedullary insert—each has advantages, although there is 100 per cent. of success by either method properly used. We have been impressed with the necessity of going wide of the eburnated sclerosed bone on the ends of the proximal and distal fragments of the fracture. This ivory-like bone has no osteogenesis and unless it is bridged with a living graft which contacts well above and below with viable bone, union will not result. A few surgeons have abandoned the use of the Lane plate, successfully substituting in its place the autogenous bone inlay, which is firmly fastened to the fractured fragments. The advantages of bone over metal are obvious.

Equally brilliant as in the transplantation of bone are the results from fascial grafts.

This tissue, also of the connective-tissue group, lends itself readily to a multitude of uses—its simple cellular construction, low vascularity and its easy accessibility make it ideal for transplantation. Lined with a layer of fat we have utilized fascia lata to fill a four-inch defect left by the removal of a cystoid scar of the dura. The tendency of the pia to form dense adhesions to adjacent tissues is here combated by the movable fat, which forms a hygroma and discounts these adhesions. Efforts are reported, where the peritoneal lining of a hernial sac or the sac of a hydrocele has been used for this purpose only to fail because of the dense adhesions formed.

In restoring the loss of tendons, we have reconstructed an entire extensor group in the forearm from the iliotibial band, then surrounded the bundle with a fascia and fat fillet to take the place of the annular

ligament of the wrist and prevent adhesions—this method gave a perfect functional result.

It is in the strengthening of large ventral hernial repairs however, that the results have been illuminating. These great hernias occur frequently in very fat women who have usually a marked diastasis and atrophy of the recti from overstretching, and as well fatty degeneration of the aponeuroses. In these cases the fascial graft is valuable as there are either enough stresses and demands put upon it to stimulate hypertrophy, or it is replaced by a dense sheet of connective tissue which is itself supportive.

Lewis has experimentally reconstructed common bile ducts from fascial tubes, these grafts remained patent and survived in the presence of sterile bile. The restoration of ureteral defects has, as well, been undertaken by this method, with a resultant viable graft, notwithstanding the flow of urine over it; here, however, there is a loss of ureteral peristalsis, with ultimate stricture and hydronephrosis.

Free fascial grafts to cover suture lines in the œsophagus, stomach and bowels are reported as successful but have not the merit of the omental graft popularized by Senn. The occlusion of the pylorus by a fascial band is as satisfactory as any method of occlusion, except resection. Fascial slings have repeatedly been used in the suspension of prolapsed kidneys.

Where there is loss of a nerve trunk and the two ends cannot be approximated, a fascial tube joining the ends conducts the proliferating axons, in the regeneration of the nerve. This method has proved as useful as the transplantation of segments of other nerves, for these lose their axons and act simply as conducting tubes.

The clever work done in arthroplasties by Murphy has popularized the use of fascial and fat flaps to cover the ends of the denuded bones in the reconstruction of joints.

While the free graft is successful in the temporomaxillary, shoulder-, elbow- and wrist-joints, it should be replaced by the pedicled flaps in the weight-bearing joints, as here the greater pressure upon it determines the necessity for a better blood supply.

In one instance we had a great bridge of bone springing from the anterior surface of the humerus under the brachialis anticus and bridging and locking the elbow-joint. After its removal, we swung in a flap of aponeurosis to cover the large area left bare of periosteum, hoping this graft would act as a limiting membrane and prevent the reformation of the exostosis. At the end of ten months, however, the bone partially reformed; it was again removed; the fascial graft was found

FIG. 1.—Non-union of both bones of forearm, showing futile use of Lane plate.

FIG. 2.—Union of "*A*" following intermedullary bone graft.

FIG. 3.—Non-union following exhibition of intermedullary bone graft. The graft was not driven far enough beyond the sclerosed bone.

FIG. 4.—Same case as Fig. 6, showing union after bone inlay, which bridged the sclerosed bone.

FIG. 5.—Recurrent exostoses of olecranon and lower end of humerus, notwithstanding the use of fascia lata to take the place of periosteum.

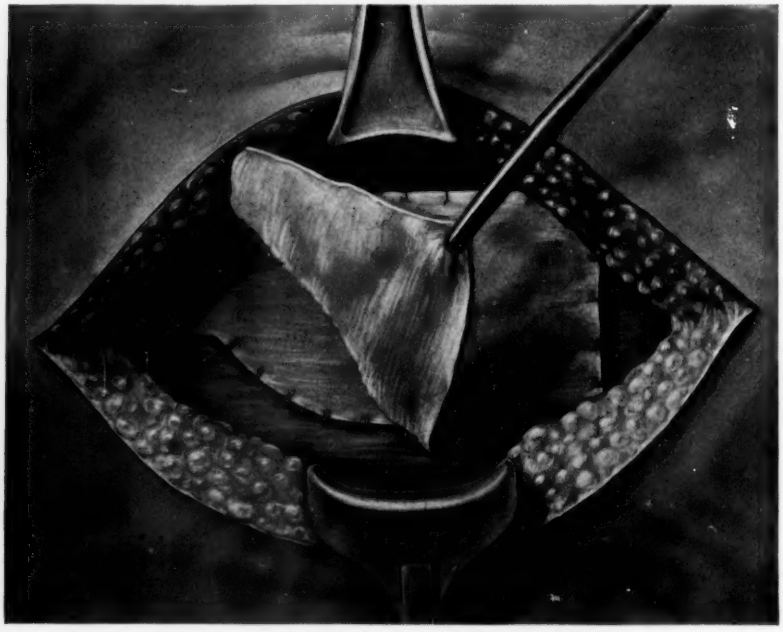

FIG. 6.—Showing method of reinforcing the Mayo ventral hernia operation by fascia lata graft.

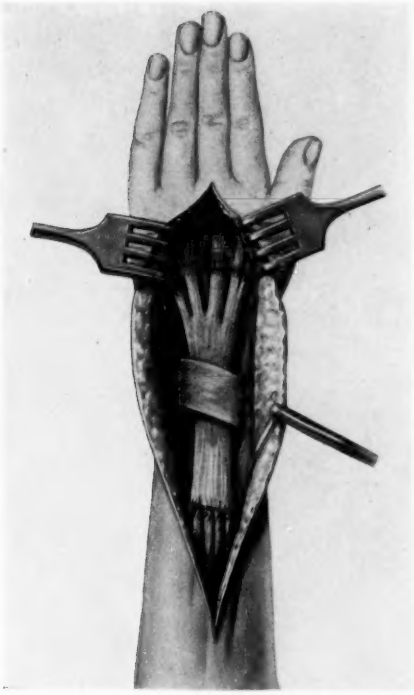

FIG. 7.—Restoration of extensor tendons of forearm, using fascia lata. Annular ligament for same made by fascia lata and fat.

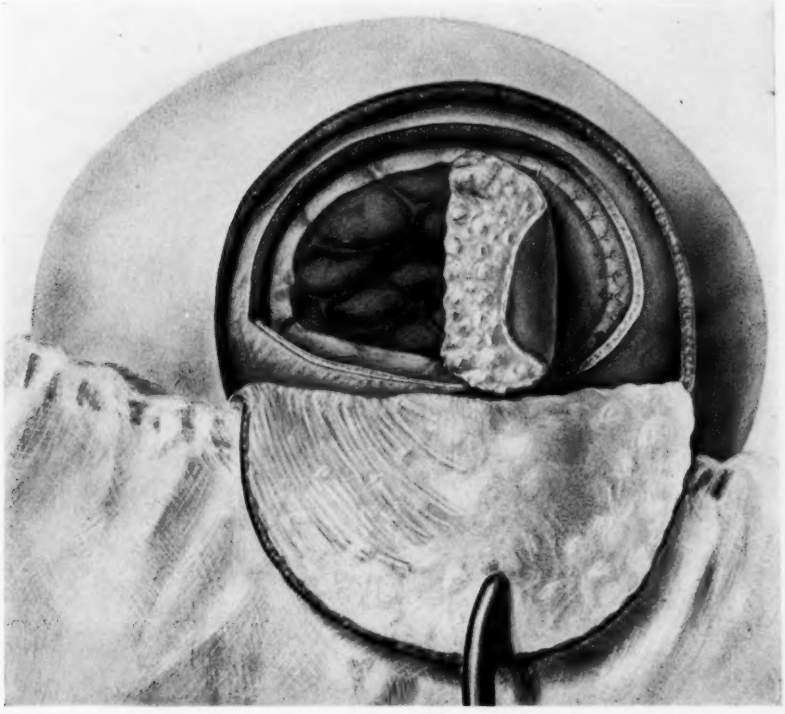

FIG. 8.—Restoration of dural defect by graft of fascia lata and fat.

FIG. 9.—Great scar from burn, binding leg and thigh together.

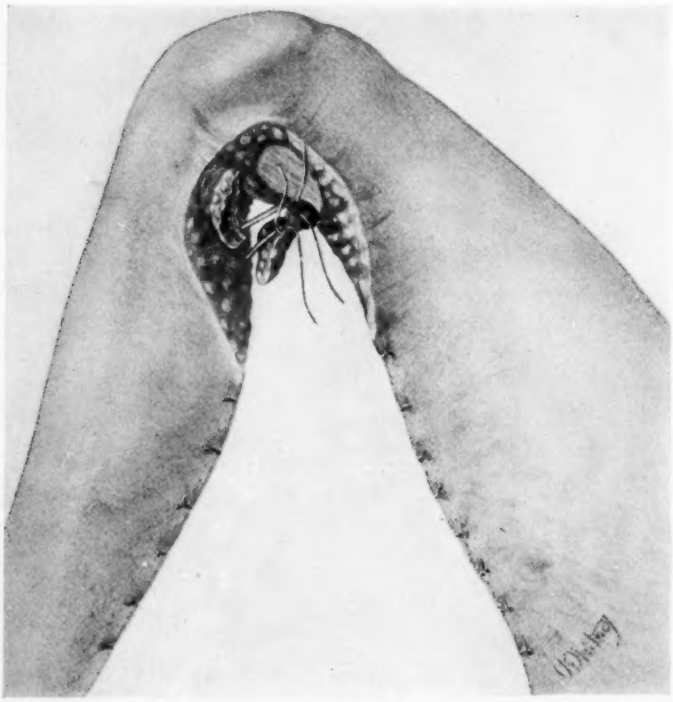

FIG. 10.—Scar released by "Z" plastic; taut nerves in popliteal space covered by fatflaps.

FIG. 11.—Showing boy after plastic and graft of his leg.

tremendously thickened and replaced entirely by scar tissue, so a free periosteal graft taken from the anterior and mesial surface of the tibia was stitched in place—this operation was done too recently to determine whether, as we are led to expect from experimentation, the transplantation of adult periosteum will limit osteoblastic proliferation.

What has been noted of fascia is applicable as well to tendon transplants. The use of one tendon transplanted and trained to do the work of another is well known. Fascia is fully as useful as tendon, but, should a section of a tendon be desired, the palmaris longus is easily available for the purpose.

Free fat is readily transplanted and is especially useful in restoring contours in the face, breast and eye sockets. We have mentioned its use together with fascia in replacing the dura, tendon sheaths, etc. From Garie's clinic come reports of its successful use in filling cavities in osteomyelitic bones, even in the presence of mild infection. We have tucked it under scars which have been bound down, and thus prevented readhesion.

One use in our hands was especially gratifying, viz.: After a burn of a child's lower limb, the scar contraction bound the leg to the thigh from the heel in contact with the buttock to the popliteal space. After a Z-plastic procedure on this vast scar, the leg was only released about 30 degrees and a large lozenge-shaped defect behind the knee could not be covered with skin. After the free dissection of the popliteal space it was found the leg could not be straightened because of the contracted, taut trunks of the internal popliteal and perineal nerves, stretching exposed and alone across the angle made by the leg and thigh, like the strings of a bass viol. Further stretching would have ruptured the axons of these taut, bare nerves. To cover them, two oval pedicled flaps of fat were dissected up from adjacent tissues, swung on their pedicles and stitched around each of the exposed nerve trunks. The limb was then vertically suspended by the foot, leaving the bare nerve and fat bands exposed to the dressings. Not only did the fat flaps live but granulated and covered in without skin grafting; a gradual stretching of the nerves permitted the leg to straighten until to-day it is normal.

A study of the various methods of skin grafting has little new to offer save that two camps have formed, one affirming that homografts do not retain their entity as such, the other believing that nearly 50 per cent. of homografts survive. Whichever theory is correct, this fact remains, that success from homotransplantation of skin by all of the methods is general, and from the clinical stand-point of results obtained does not differ from those observed in the use of the autograft.

Monks called our attention to the transplantation of whole skin with its nutrient temporal artery alone serving as a pedicle: the flap is swung from the temporal region to the face. One important consideration of whole skin transplantation has not been sufficiently emphasized, viz.: the need of scarification of the epidermis of the graft to permit of lymphatic drainage until such time as new blood-vessels and lymph channels are formed.

In the field of blood-vessel plastic work, Matas has reported occlusions, partial and complete, of arteries by transplantation of a spiral segment of an arterial wall wrapped around the vessel. He has used fascial bands with like results. (Carrell's brilliant work in blood-vessel transplantation is common knowledge and needs no discussion, save to emphasize that the segment ultimately becomes a connective-tissue tube: whether the muscle survives is still debated.) A segment of vein has been used to replace the urethra but with indifferent success; better results were obtained in its use as a drain for the ventricles in hydrocephalus.

The free transplantation of the mucous membrane is extremely limited in its application and aside from its occasional use in the mouth or the conjunctival sac, it is rarely used.

Lexer reports brilliant results from the utilization of the patient's own appendix to remedy the congenital absence of, or the loss of, his urethra. He used the mucous lining only, stripping it free of muscle and serosa; this gave a patent and useful urethra. Until this healed in, he maintained a bladder fistula to keep his field clean.

The resected cæcum with its attached appendix, used as a bladder and a urethra in exstrophy of the bladder, has been clinically successful. Here the ureters or the base of the bladder with the ureteral orifices are implanted into the cæcal wall and the cæcum and appendix with their nourishing blood-vessels are transplanted bodily to the pelvis.

Stewart and others have in like manner successfully utilized a segment of the small bowel to make a new vagina.

Transplantation of glandular organs with elaborate anastomosis of arteries and veins is not successful, for, while vascularization is feasible, innervation is not, and the complex tissues do not survive.

The early optimistic reports of experimental success in the grafting of the ductless glands led the profession to expect that such procedures would be of clinical value; the test of time, however, has proven them to be practically useless. There is still a difference of opinion existing as to the feasibility of both auto- and homotransplants of parathyroids in parathyroprivia; the belief prevails, however, that for some time,

or at least until the transplants are absorbed, the internal secretion of these parathyroids is sufficient to avert tetany, especially if reënforced by the exhibition of calcium lactate.

Homografts of thyroid glands are not successful, they are always absorbed. Autografts, however, have been reported which were feebly functionating after two years.

While these results are interesting as surgical experiments, they have little value from a clinical stand-point, save in the rare instances of accidental total removal of the parathyroids or thyroid, and here greater relief is obtained, in the case of the thyroid at least, by organotherapy.

Tuffier's work in ovarian transplantation has proven that the homografts are failures, he asserts as well that reimplantation of ovaries after total hysterectomy is useless; however, his results in reimplantations where the uterus was not removed were brilliant, for the patients menstruated, more or less regularly, and were spared the discomforts of the artificial menopause.

The greatest problem of the future is the prevention of immunity or the antagonism of the fluids of one body to the tissues of another.

If our present-day views of the question of autografts are a criterion of the past, the future holds possibilities which "bulk big" with the probability of successfully transplanting tissues, glands or organs, which up to date have defied the skill of the greatest of technicians.

FRACTURES OF THE FEMUR

WITH END RESULTS IN 62 CASES

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The poor functional and anatomical results in fractures of the long bones of the extremities led the American Surgical Association and the British Medical Association to investigate the causes for such results. A waning interest in fractures has been renewed, and with the form-blanks covering all the important facts to be obtained concerning fractures, more uniform, complete and exact data are being gathered.

Much has been written concerning fractures of all bones but the femur presents some of the greatest difficulties to be encountered, while its anatomical and physiological importance accentuates the necessity for a good result.

In considering fractures of the femur it is well to take them up in different groups according to the portion of the bone fractured, such as those of the upper end (neck and through the trochanters), the shaft and the lower end. The varieties, manner of production and treatment of fractures have been so thoroughly dealt with in the special fracture number of the *American Journal of Surgery* for March, 1915, by such authorities as A. Lane, W. L. Estes, A. P. C. Ashhurst, F. H. Albee, J. B. Walker and others, that they will not be considered in this paper except as they concern reported cases.

With the more general use of the Röntgen rays we are enabled to see the exact position of the fragments before and after treatment, so we can follow cases to observe how kind nature is in producing generous callus to cover our defective reductions, with resultant solid union (Figs. 1, 2, 3, 4, 5, 6 and 7). The anatomical relation of the fragments may be bad and still give a good functional result (Table IV).

The basis of this article consists of the fractured femurs from Dr. Charles H. Frazier's service at the Episcopal Hospital during the 10 years from 1905 to 1915, and I am indebted to him for the privilege of reporting the cases.

Of the 109 cases on record we were able to follow 62 (57 per cent.), 15 fractured through the neck, 6 through the trochanters, 36 of the shaft, and 5 of the lower end. A number of the cases have been previously reported more in detail before this Academy and elsewhere

* Read before the Philadelphia Academy of Surgery, May 3, 1915.

by Dr. A. P. C. Ashhurst.[1] Of the 47 fractures not followed there were 4 each through the trochanters and of the lower end, 15 of the neck and 24 of the shaft; the condition of the patients at the time of discharge was as follows: 10 cured, 24 recovered, 10 improved, 1 at own request, and 2 refused treatment.

Considering the fractures of the neck there were 10 females and 5 males, with ages ranging from 14 to 84 years (average 64½). All were simple fractures produced by indirect violence. The time in the hospital ranged from 2 to 29½ weeks (average 6⅔), while the average time from work of those who survived was 22½ weeks. Of the 8 cases dying in the hospital (5 intracapsular) 6 were females and 2 males, with ages ranging from 65 to 84 years (average 74½). The cause of death was given as 1 each from uræmia, senility and carcinoma of the stomach (autopsy confirmation), 2 from pneumonia, while in 3 it was not stated. A peculiar fact is noted in that 6 of these occurred during the services of 1905 and 1906, but no definite explanation for this was found. The functional and anatomical results are given in Table I.

There were 6 cases of simple fracture through the trochanters (Table II), all being of the male sex and treated non-operatively. Three were caused by direct and 3 by indirect violence. The number of weeks in the hospital averaged 7 with extremes from 4 to 10, while the time from work averaged 34 weeks, varying from 12 to 93. The earning power was less in 4 cases, each having a moderate anatomical result with moderate to bad functional result, while the 2 with the same earning capacity had both good anatomical and functional results.

Of the 5 cases where fracture occurred at the lower end of the femur, again they were all of the simple type produced by direct violence, all males with ages ranging from 6 to 61 years (average 34). One case with bad position of the fragments was plated with resultant good apposition but only moderate return of function. Here the time in the hospital varied from 2 to 11 weeks (average 5½), the patient going out in 2 weeks had the limb in a plaster cast returning later for the removal of the cast. The earning capacity in these cases was the same in 2 and less in 2; the fifth developed delirium tremens and died after 3 weeks. Functional and anatomical results are shown in Table III.

Over half the cases followed were fractures of the shaft, 33 males and 3 females with ages from 3 to 74 years (average $23^{1}/_{3}$). Five of the cases were plated because of the inability to obtain proper re-

[1] Ashhurst, A. P. C.: Fractures Through the Trochanters of the Femur. ANNALS OF SURGERY, Philadelphia, 1913, October, p. 495; also, The Prevention and Treatment of the Disabilities Following Fractures of the Limbs. American Journal of Surgery, 1915, xxix, 114.

duction; 3 good and 2 moderate anatomical results followed, and 4 good and 1 moderate functional result. The time in the hospital ranged from 1 day to 59 weeks (average 10 weeks). One case died of shock the day of admission, while another died on the third day of a fractured skull. The disability period was between 8 and 115 weeks (average 16.9), giving 29 good, 4 moderate, and 2 bad functional results from 25 good, 6 moderate and 4 bad anatomical results. The case who stayed in the hospital 59 weeks and was out of work 115, developed delirium tremens, got the leg in bad condition, causing sloughing of tissue, when a cast was applied, with both bad anatomical and functional results. Thirty cases were of the simple type, while Cases 3, 9, 19, 26, and 27 were comminuted, and Case 11 compound, the fracture having been produced by indirect violence (see Figs. 2 to 7). Twenty-four fractures resulted from direct and 12 from indirect violence.

Tables V, VI, VII, VIII, and IX have been compiled so that the various summaries of results, such as age groups, disability periods, etc., of the different classes of fractures may be noted at a glance.

As to treatment the non-operative gave as good results, functionally, as the operative, although the plated cases were selected, which without operation most certainly would have given poor results. Anatomical results were based on röntgenograms when they were employed and in the other cases on the amount of shortening or deformity. The latter is faulty in that good approximation and alignment of the fragments is not necessary for a straight and unshortened limb. The skiagraph is the only accurate basis for our conclusions, but unfortunately not all had röntgenograms after completed treatment.

The mortality of 11 cases was not due directly to the fracture of the femur excepting in the one dying from shock, while in a number of the others it was a contributing factor.

In conclusion from the facts gathered:

1. Fractures of the neck were more frequent in the aged of the female sex, indirectly cause a high mortality because of the age of the patient and the lowered resistance, and give a moderate disability period.

2. Fractures through the trochanters were all males and gave a long disability period with lowered earning capacity in two-thirds of the cases.

3. Fractures of the lower end of the femur gave an average disability of about 6 months while a good functional result was obtained in about one-half of the cases. They were all males.

4. Fractures of the shaft gave the best results and had the shortest disability period. They were the most frequent and were mostly males.

5. The mortality from fractures of the femur other than of the neck was low, being about 2 per cent. in this series.

FIG. 1.—J. F., aged fifty years, who had broken his left femur shaft thirty years previous to this X-ray. He has two and one-half inches shortening, wears a high shoe and makes good wages, but says he could make one-third more if not for his disability. He has some pain in region of fracture during damp weather. Plate shown to illustrate the way nature cares for defects, giving moderate functional result.

FIG. 2.—Case 11 of Table IV, under Fractures of the Shaft, which was compound. E. F., girl seven years of age. Lateral view before setting under ether. Had 3 cm. shortening. Left femur.

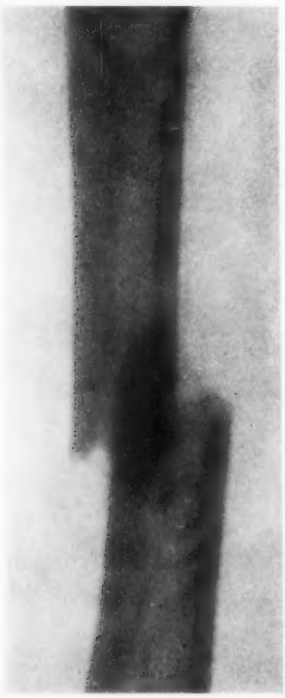

FIG. 3.—Same case as Fig. 2. Anteroposterior view before setting under ether.

FIG. 4.—Same case as Fig. 2. Lateral view after setting under ether.

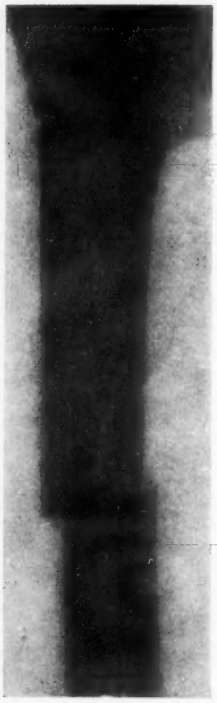

FIG. 5.—Same case as Fig. 2. Anteroposterior view after setting.

FIG. 6.—Same case as Fig. 2. Lateral view six months after setting.

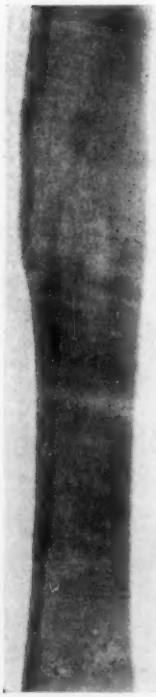

FIG. 7.—Same case as Fig. 2. Anteroposterior view six months after setting.

FIG. 8.—G. O'N., twenty years of age, fracture of femoral shaft. Lateral view.

FIG. 9.—Same case as Fig. 8. Anteroposterior view.

FIG. 10.—Same case as Fig. 8. Dr. C. H. Frazier's service, Episcopal Hospital. Operated by Dr. A. P. C. Ashhurst, November 17, 1914, with good result. X-ray of limb four weeks after Lambotte plate was applied.

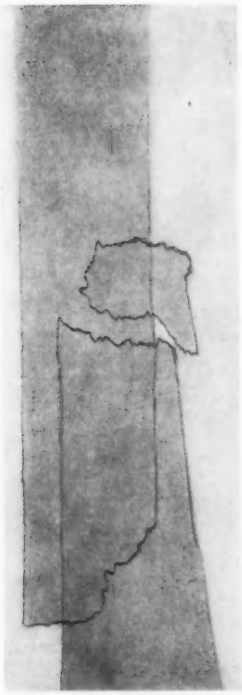

FIG. 11.—F. R., twenty-six years of age. Fracture of femur.

FIG. 12.—F. R. Same as Fig. 11, six weeks after operation (late).

TABLE I

Fractures of Neck of Femur

No.	Sex	Age	Treatment		X-ray		Weeks in hospital	Weeks from work	Earning power	Functional result			Anatomical result			Died
			Operative	Non-operative	Early	Late				Good	Mod.	Bad	Good	Mod.	Bad	
1	M	14	..	C	*	*	6	10	Same	*	..	..	*	..	..	
2	M	30	..	†	*	..	4	30	Less	..	..	*	..	..	*	
3	F	58	..	†	*	*	29½	Idle	Idle	..	*	..	..	*	..	
4	F	60	..	E and L	..	..	6	24	Same	*	..	..	*	..	..	
5	M	63	..	E	..	..	11	Idle	Idle	*	..	..	..	*	..	
6	M	65	..	†	..	..	2½	..	..	..	..	..	..	..	..	Pneumonia.
7	F	67	..	E	..	*	6½	26	Same	*	..	..	*	..	..	
8	F	70	..	E	*	..	17	..	..	..	..	..	..	..	..	Uræmia.
9	F	70	..	†	*	..	2	..	..	..	..	..	..	..	..	Cause not stated.
10	F	74	..	C	*	..	2½	..	..	..	..	..	..	..	..	Carcinoma of stomach.
11	F	75	..	E and C	..	..	3	..	..	..	..	..	..	..	..	Senility.
12	F	76	..	†	..	..	4	Idle	Idle	..	*	..	..	*	..	
13	F	77	..	†	..	..	6	..	..	..	..	..	..	..	..	Cause not stated.
14	M	82	..	E	..	..	2	..	..	..	..	..	..	..	..	Cause not stated.
15	F	84	..	†	..	..	2	..	..	..	..	..	..	..	..	Pneumonia.
Total	M F	Ave.					Ave.	Ave.	Same 3							
15	5 10	64½	0	15	6	3	6⅔	22½	Less 1 Idle 3	4	2	1	3	3	1	8

Note.—Case 3 died 3 years later. Case 5 died 5½ years later.

Key to tables:

Mod.=Moderate.
E=Buck's extension.
L=Lateral extension.
VE=Vertical extension.
C=Plaster-of-Paris cast.
H=Hamilton splint.
S=Splint.
Splint=Coaptation splint.
SB=Sand bags.
†=Type not stated.
Idle=Not working, being too old or for other cause.
*=Time X-rays were taken and end result in each case.

TABLE II

Fractures Through Trochanters

No.	Sex	Age	Treatment		X-ray		Weeks in hospital	Weeks from work	Earning power	Functional result			Anatomical result			Died
			Operative	Non-operative	Early	Late				Good	Mod.	Bad	Good	Mod.	Bad	
1	M	42	..	S and C	*	..	8	27½	Less	..	*	..	..	*	..	
2	M	45	..	E	*	..	6½	12	Same	*	..	..	*	..	..	
3	M	48	..	E	*	..	4	48	Less	..	*	..	..	*	..	
4	M	54	..	E	*	..	4½	9½	Same	*	..	..	*	..	..	
5	M	54	..	E and S	*	..	10	93	Less	..	..	*	..	*	..	
6	M	70	..	†	*	..	8	over 14½	Less	..	..	*	..	*	..	
Total 6	6	Ave. 52	0	6	6	0	Ave. 7	Ave. 34	Same 2 Less 4	2	2	2	2	4	0	

TABLE III

Fractures of Lower End of Femur

No.	Sex	Age	Treatment		X-ray		Weeks in hospital	Weeks from work	Earning power	Functional result			Anatomical result			Died
			Operative	Non-operative	Early	Late				Good	Mod.	Bad	Good	Mod.	Bad	
1	M	6	..	C	*	..	4	4	Same	*	..	..	*	..	..	
2	M	30	..	E and C	*	..	7½	28	Same	*	..	..	*	..	..	
3	M	35	Plate	....	..	..	11	34	Less	..	*	..	*	..	..	
4	M	38	..	E and C	*	..	2	28	Less	..	..	*	..	*	..	
5	M	61	..	†	..	..	3	....	....	..	..	..	..	..	..	Delirium tremens.
Total 5	5	Ave. 34	1	4	3	0	Ave. 5½	Ave. 23½	Same 2 Less 2	2	1	1	3	1	0	1

TABLE IV

Fractures of Shaft of Femur

No.	Sex	Age	Treatment		X-ray		Weeks in hospital	Weeks from work	Earning power	Functional result			Anatomical result			Died
			Operative	Non-operative	Early	Late				Good	Mod.	Bad	Good	Mod.	Bad	
1	F	3	..	E	*	..	7	13	Same	*	..	..	*	..	..	
2	M	3	..	VE	*	..	8	8	Same	*	..	..	*	..	..	
3	M	3	..	H and E	*	..	8	8	Same	*	..	..	*	..	..	
4	M	4	..	E and C	..	..	9	12	Same	*	..	..	*	..	..	
5	M	4	..	E and C	..	..	6	9	Same	*	..	..	*	..	..	
6	M	5	..	E	*	*	9½	11	Same	*	..	..	*	..	..	
7	M	5	..	H and E	*	*	8	9	Same	*	..	..	*	..	..	
8	M	6	..	H and E	*	..	12	17	Same	*	..	..	*	..	..	
9	M	6	..	H and E	*	..	6	8	Same	*	..	..	*	..	..	
10	M	6	..	C	*	..	7	9	Same	*	..	..	*	..	..	
11	F	7	..	E and C	*	*	8	10	Same	*	..	..	..	..	*	
12	M	7	..	H and E	*	..	11½	11½	Same	*	..	..	*	..	..	
13	M	8	..	E and SB	..	..	8½	13	Same	*	..	..	*	..	..	
14	M	10	..	E	..	..	6	9	Same	*	..	..	*	..	..	
15	M	11	Plate	....	*	*	11	14	Same	*	..	..	*	..	..	
16	M	13	..	E and C	*	..	6½	12	Same	*	..	..	*	..	..	
17	M	13	..	C	..	..	7	14	Same	*	..	..	..	*	..	
18	M	14	Plate	....	*	*	15	19	Same	..	*	..	*	..	..	
19	M	15	..	E	*	*	12½	30	Same	*	..	..	..	..	*	
20	M	16	Plate	....	*	*	12	20	Same	*	..	..	..	*	..	
21	M	18	..	Splint	*	*	13	17	Same	*	..	..	*	..	..	
22	M	18	..	Splint	*	*	13	17	Same	*	..	..	*	..	..	
23	M	21	..	†	..	..	1 day	..	....	..	..	..	..	..	..	Shock.
24	M	23	Plate	....	*	*	13	21	Same	*	..	..	..	*	..	
25	M	34	..	E and C	..	..	7½	19	Less	..	*	..	*	..	..	
26	M	34	Plate	....	*	*	10	26	Same	*	..	..	*	..	..	
27	M	38	..	Splint	*	*	8	24	Same	*	..	..	*	..	..	
28	M	45	..	C	..	..	9	20	Same	*	..	..	..	*	..	
29	M	47	..	E and C	*	*	59	115	Less	..	..	*	..	..	*	
30	M	50	..	†	..	..	3 days	....	....	..	..	..	..	..	..	Fractured skull.
31	M	50	..	C	..	*	6	12	Same	*	..	..	*	..	..	
32	M	50	..	E and SB	*	*	6½	9½	Same	*	..	..	*	..	..	
33	M	52	..	HE and C	*	*	7	21	Same	..	..	*	..	..	*	
34	M	53	..	E	..	..	15	26	Less	..	*	..	..	*	..	
35	M	73	..	E and C	*	*	14	Idle	Same	..	*	..	..	*	..	
36	F	74	..	†	..	..	7	Idle	Same	*	..	..	*	..	..	
Total 36	M F 33 3	Ave. 23⅓	5	31	24	17	Ave. 10	Ave. 16.9	Same 31 Less 3	28	4	2	24	6	4	2

TABLE V

Fracture of Femur

FRACTURE LEVEL ACCORDING TO AGE WITH AVERAGE DISABILITY IN WEEKS

	Total	Under 15 years			15 to 45			45 to 60			60 and over		
		Non-operative	Operative	Average disability	Non-operative	Operative	Average disability	Non-operative	Operative	Average disability	Non-operative	Operative	Average disability
Neck	15	1	..	10	1	..	30	..	..	....	12	..	25
Trochanters	6	..	..	....	1	..	27.5	4	..	17.3	1	..	14.5
Upper	5	2	..	....	2	1	....	..	..	....	..	..	....
Middle	28	13	2	....	4	1	....	7	..	....	1	..	....
Shaft, lower	1	..	..	....	..	..	....	..	..	....	1	..	....
?	2	1	..	....	..	1	....	..	..	....	..	..	....
Total	(36)	(16)	(2)	11.3	(6)	(3)	21.7	(7)	..	34	(2)	..	Over 52. *
Lower end	5	1	..	4	2	1	22	..	..	1	..	..	
Sum totals	62	18	2	....	10	4	....	11	0	....	15	0	....

* The 11 cases which died early are not considered in Average Disability.
? Region of shaft not stated.

TABLE VI

Fracture of Femur

DISABILITY PERIOD ACCORDING TO ANATOMICAL RESULT AND AGE

	Total	Anatomical result				Under 15 years	15–45	45–60	Over 60
		Good	Moderate	Bad	Died				
Under 6 weeks	11	1	..	..	10	1	1	1	8
6 to 12 weeks	16	16	..	..	..	12	..	4	..
3 to 6 months	19	11	5	2	1	7	7	2	3
6 to 9 months	8	4	3	1	..	..	6	1	1
9 to 12 months	1	..	1	..	..	..	..	1	..
Over 12 months	4	1	2	1	..	..	..	2	2
Not stated	3	..	3	..	..	..	..	1	2
Total	62	33	14	4	11	20	14	12	16

TABLE VII

Fracture of Femur

FUNCTIONAL AND ANATOMICAL RESULTS ACCORDING TO AGE (NON-OPERATIVE AND OPERATIVE)

	Total	Under 15		15 to 45		45 to 60		60 and over	
		Non-operative	Operative	Non-operative	Operative	Non-operative	Operative	Non-operative	Operative
Functional:									
Good	36	18	1	5	3	5	..	4	..
Moderate	9	..	1	2	1	3	..	2	..
Bad	6	..	..	2	..	3	..	1	..
Death	11	..	..	1	..	1	..	9	..
Anatomical:									
Good	33	17	2	5	2	4	..	3	..
Moderate	14	1	..	2	2	5	..	4	..
Bad	4	..	..	2	..	2	..	..	..

TABLE VIII

Fracture of Femur

FUNCTIONAL RESULTS ACCORDING TO ANATOMICAL RESULTS

	Total	Functional		
		Good	Moderate	Bad
Anatomical:				
Good	33	30	3	..
Moderate	14	5	6	3
Bad	4	1	..	3
Total	51	36	9	6

TABLE IX

FRACTURE OF FEMUR

SUMMARY TABLE

Location	Number	Sex		Age in years			Treatment		Time in hospital in weeks				Weeks absent from work				Earning capacity		Functional result			Anatomical result			Died
		Male	Female	Average	Old	Young	Operative	Non-operative	Total	Average	Long	Short	Total	Average	Long	Short	Same	Less	Good	Moderate	Bad	Good	Moderate	Bad	
Neck	15	4	11	64½	84	14	0	15	100	6⅔	29½	2	90	22½	30	10	7	8	4	2	1	3	3	1	8
Trochanter	6	6	0	52	88	46	0	6	41	7	10	4	204	34	91	9½	2	4	2	2	2	2	4	0	0
Shaft	36	33	3	23⅓	74	3	5	31	362	10	59	½	571	16 9/10	115	8	31	5	29	4	1	25	6	4	2
Lower extremity	5	5	0	34	61	6	1	4	27½	5½	11	2	94	23½	34	4	2	2	2	1	1	3	1	0	1
Totals	62	48	14	37	88	3	6	56	530	9	59	½	959	20	115	4	42	19	37	9	5	33	14	5	11

NOTE:

	Under 15 years	Over 15 years
Neck	1	14
Trochanters	0	6
Shaft	19	17
Lower end	1	4

Result of Operated Cases

Shaft.....4 good and 1 moderate functional.
4 good and 1 anatomical moderate.
Lower end.....1 good anatomical and moderate functional.

END RESULTS IN FRACTURES OF BOTH BONES OF THE LEG *

By Rutherford L. John, M.D.
of Philadelphia, Pa.

In presuming to bring forward the subject of fractures of both bones of the leg, this paper has no intention of discussing the question of treatment. It will limit itself to a statement of the end results in a series of 40 cases, that being the number I was able to follow up of 288 cases treated in the Episcopal Hospital between the years 1905 and 1915.

Of the forty cases followed, 6 were compound and 34 not compound fractures, *i.e.*, they were either simple or comminuted.

Group I classes cases as to age, sex, and leg involved, as follows:

Years	No. cases	Male	Female	Right	Left
0–14	7	6	1	3	3
15–44	22	13	9	13	8
45–59	9	7	2	5	4
60–	2	0	2	2	0
	—	—	—	Two cases unnoted	
Total	40	26	14	23	15

As can be seen from the table, by far the greater number of cases occurred between the ages of 15 and 44 years, 22 out of 40, or 55 per cent. Males were involved in 65 per cent., and 57.5 per cent. of the fractures occurred in the right leg.

Group II gives us one of the most interesting classifications of the series. Here I have endeavored to show the effect of the anatomical result on the period of disability. The period of disability has been taken to mean the number of weeks the patient was kept from his work. The measurements were made from the lower border of the patella to the internal malleolus.

Group II a. (All Cases)

Anatomical result	Amt. of shortening	No. cases	Aver. period disability
Good	0–0.99 cm.	17	14.8
Moderate	1.0–1.99 cm.	16	21.7
Bad	2.0– cm.	6	45.3

The above group includes all cases. The following table gives the same data for cases not compound:

* Read by invitation before the Philadelphia Academy of Surgery, May 3, 1915.

GROUP II B. (CASES NOT COMPOUND)

Anatomical result	Amt. of shortening	No. cases	Aver. period disability
Good	0–0.99 cm.	15	14.5
Moderate	1.0–1.99 cm.	14	20.1
Bad	2.0– cm.	4	42.0

While in the above tables, a shortening of from 1.0 to 1.99 cm. is classed as a moderate *anatomical* result, yet in practically all of these cases there was a very good *functional* result, the patients being able to do their former work without any loss of endurance or knowledge of the shortening of one leg.

Of all of the cases followed, there had been no open operative treatment in any of the simple or comminuted fractures. Two cases of comminuted fractures (X-ray photographs, Figs. 1, 2, 3 and 4) were treated by the Steinmann nail traction. Both of these cases healed with no shortening. The average period of disability for these two cases was 12.5 weeks, as compared with the average period of 15 weeks for the other 15 cases in the same group. Both cases were badly comminuted and, aside from the more rapid recovery and the perfect anatomical result, the Steinmann nail traction allowed these patients, while under constant traction, to move about a bit in bed, a fact which gave them considerable comfort and of which they speak with gratitude. That traction by means of the Steinmann nail is not always so satisfactory can be realized from a glance at Fig. 5. This case of compound fracture of both bones had a Steinmann nail driven through the os calcis on the sixth day after injury and twenty-two pounds of weight applied for twelve days, with no apparent reduction of the deformity. The bones were then exposed and the tibia plated, with an ultimately good anatomical and functional result (see Fig. 6).

The six compound cases of the series are grouped in the following table to show age periods and operative treatment:

GROUP III

Years	No cases	No. oper.	Immed. oper.	Delayed oper. (after 10 days)
0–14	2	1	1	
15–44	4			4
45–59	0			
60–	0			

Group IV shows the compound cases grouped as to amount of shortening and average period of disability:

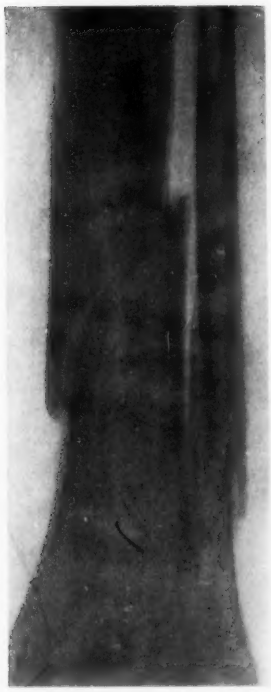

FIG. 1.—Comminuted fracture of tibia and fibula before treatment by Steinmann nail traction. See Fig. 2.

FIG. 2.—Comminuted fracture of tibia and fibula treated by Steinmann nail traction (sixteen pounds). Five months after injury; no shortening.

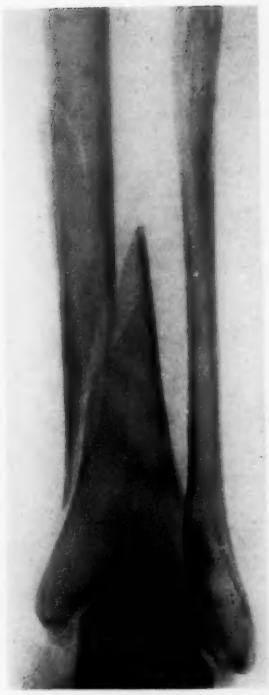

FIG. 3.—Comminuted fracture of tibia and fibula before treatment by Steinmann nail traction. See Fig. 4.

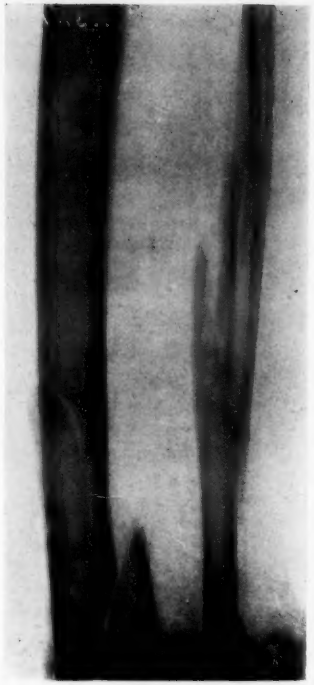

FIG. 4.—Comminuted fracture of tibia and fibula treated by Steinmann nail traction. Twenty days after injury; no shortening.

FIG. 5.—Compound fracture of tibia and fibula after Steinmann nail traction for twelve days (twenty-two pounds). See Fig. 6.

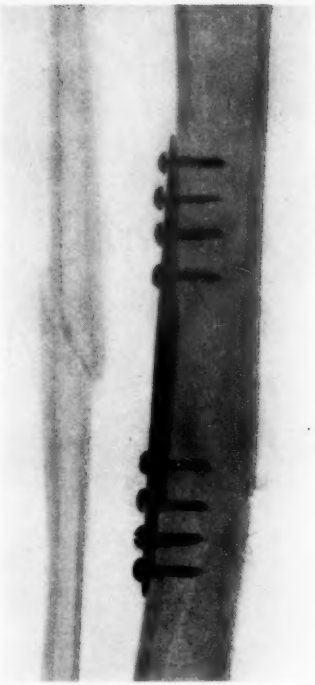

FIG. 6.—Compound fracture of tibia and fibula. Tibia plated eighteen days after injury; shortening 1 cm.

END RESULTS IN FRACTURES OF LEG

Group IV

Amt. of shortening	No. cases	Aver. period of disability
0–0.99 cm.	2	16
1.0–1.99 cm.	2	24
2.0– cm.	2	52

The following table gives the average period of disability in weeks for each region of bone considered, according to age periods.

Group V

AVERAGE PERIOD OF DISABILITY

Years	Upper ⅓		Middle ⅓		Lower ⅓	
0–14	11.5	(2)	15	(2)	15	(3)
15–44	0		16	(2)	23+	(19)
45–59	0		86	(2)	21.4	(8)
60–	0		0		9	(2)

The figures in parentheses represent the number of cases in each region. While Pott's fractures are not included in the series, it will be noted that the great majority of cases occurred in the lower third of the leg.

The conclusions to be drawn from these tables point to neither a strictly conservative nor a radical operative treatment as giving the best ultimate results. As so often stated, the majority of fractures occurred in males, between 15 and 40 years of age.

1. The right leg was affected in 57.5 per cent. of cases.

2. The average period of disability is directly dependent upon the anatomical result.

3. A moderate anatomical result may mean a perfect functional result.

4. Traction by means of the Steinmann nail would seem to be a hopeful compromise between a conservative and an operative treatment of obstinate cases.

5. The lower third of the bone is the most often involved but this fact has no apparent relation to age or period of disability.

6. The average time for reduction was on the day of injury except in four cases of compound fractures.

TRANSACTIONS
OF THE
NEW YORK SURGICAL SOCIETY

Stated Meeting, held May 12, 1915

The President, Dr. Frederic Kammerer, in the Chair

RECURRING APPENDICEAL FISTULA

Dr. George Woolsey presented a patient, a woman, fifty-three years of age, who had been operated upon eighteen years ago for appendicitis, the appendix being supposedly removed. After that, she was well until four years ago, when she began to suffer from severe pain over the appendix region, which became swollen and tender. She was operated upon at the Hudson Street Hospital for pericæcal abscess, and the wound healed after some time. Two years ago pain and tenderness appeared over the scar and she suffered from distention and nausea, but had no vomiting. The bowels were constipated, but had been regular since the first operation. Dr. Woolsey operated upon her at the Presbyterian Hospital on May 7, 1912, going through the appendix scar and encircling the fistula. The cavity was found to contain pale green gelatinous material, also some soft white material with dirty streaks, and yellow mucopurulent material, which had a decided fecal odor. It presented somewhat the appearance seen in some ovarian cysts. An abdominal incision was made, and the pelvic viscera were explored and found to be normal. The patient left the hospital with a small sinus, two weeks after her admission. In March of 1913, she was admitted to Bellevue Hospital with a swelling in the region of the cicatrix, and with a fistula discharging whitish pus and other material thought to be fecal. The odor of the discharge was fecal. The patient thought there was flatus coming through the fistula at times. An X-ray was taken and showed no intestinal fistula, but only a rather high cæcum. She was again operated upon on April 6, the incision going through the old scar. The cæcum was found to be adherent to the abdominal wall, and was dissected free. A probe was passed into the fistulous tract for two inches and was then arrested. It was thought that a fecal fistula would be found, but instead of this two inches of the distal end of a large appendix was found, which had not been

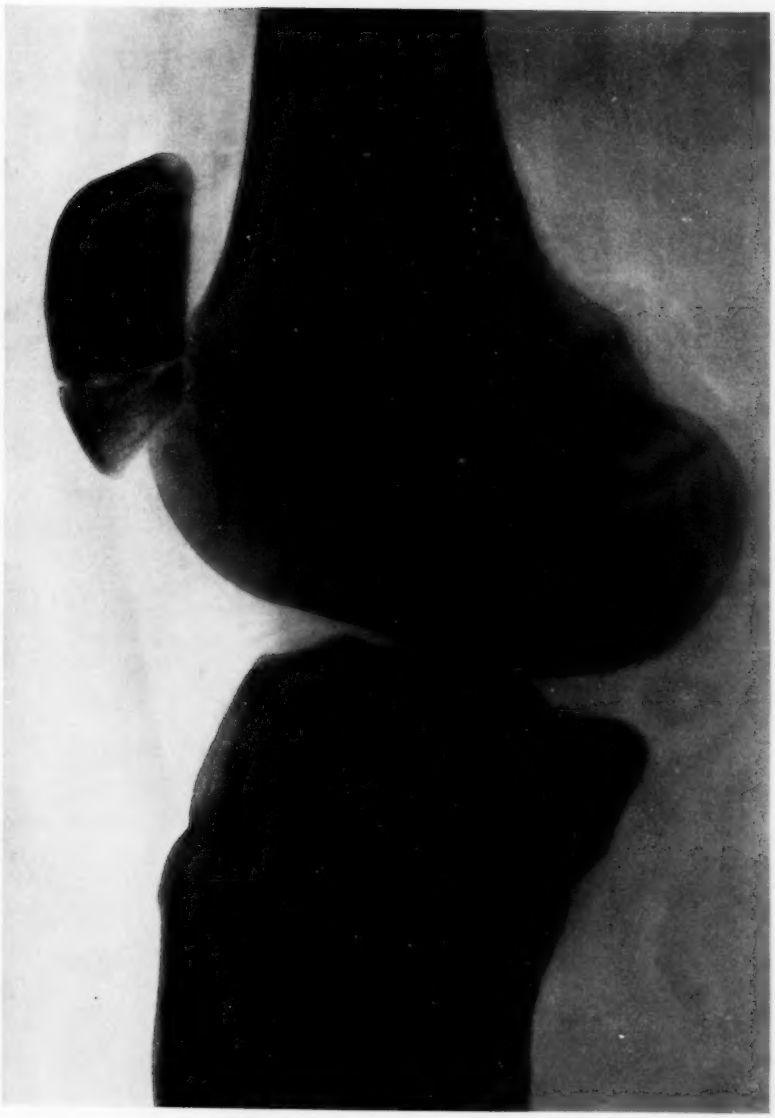

FIG. 1.—Fracture of patella from direct violence; bony union.

removed. There were no other abnormalities, and the wound was closed. There is now no opening at all.

Dr. Arthur S. Vosburgh cited a case where the recurring fistula, unlike Dr. Woolsey's case, could not be ascribed to the persistence of the mucous membrane. The man in question had been operated for a diverticulitis. The abscess had been drained, the diseased portion of the bowel had not been excised. The tract leading to the bowel would not remain permanently healed. The patient had a constantly recurring fistula, discharging sometimes a little pus and at others a little fecal matter. A probe could be passed along the tract four or five inches and there its end seemed to enter a free cavity. Dr. Vosburgh operated, and deep within the abdomen, lying in the portion of the tract communicating with the sigmoid, found a small piece of rubber tissue. It was certain that the patch had not come from any of the gloves used at the operation. It had evidently been left in the tract at some previous time, not necessarily at the first operation, but possibly at some dressing, and that accounted for the non-closure of the fecal fistula seated deep in the belly.

Dr. Parker Syms said that he had seen a case somewhat similar to that presented by Dr. Woolsey. He had operated on a man for an acute perforated appendix, with a large abscess. The appendix was not removed. Some months later, the man had trouble again. An abscess formed, which opened spontaneously and a fistulous tract resulted. In operating for the purpose of closing this fistulous tract, it was found that it consisted of the appendix. The appendix was almost in contact with the skin. The appendix was removed and the patient was cured.

FRACTURE OF PATELLA: BONY UNION WITHOUT TREATMENT

Dr. Syms presented a patient, O. S., twenty-eight years of age, who had been admitted to Lebanon Hospital on November 29, 1914, with a dislocated external semilunar cartilage. A month before admission the patient had been thrown from the seat of a wagon, and struck his knee on the curbstone with the leg in a flexed position. At that time, he reported to the out-patient department, but the doctor who saw him failed to recognize the condition and allowed him to go home, telling him to keep his leg quiet on account of the swelling and pain; but no fixation apparatus was applied. When he was finally admitted to the hospital in November, a clinical diagnosis of a displaced and movable semilunar cartilage was made. An X-ray picture (Fig. 1) revealed the fact that the patient had had a fracture of the patella, which had united in good position in spite of the fact that no treatment had been employed.

Of course, the patella had been fractured by direct violence. The good result obtained was due to the fact that the quadriceps tendon was not lacerated through at the time of injury, so that the fragments of the patella were not pulled apart, but were held in their normal position by the tendon, and the patient was able to walk because his tendon was essentially intact.

RUPTURE OF QUADRICEPS FEMORIS TENDON

Dr. F. Kammerer presented a man of sixty-four, who had sustained a rupture of the right quadriceps tendon. The patient was crossing the street, when he slipped and fell to the ground. He had no pain whatever, but was unable to rise and to extend the injured limb at the knee. He was treated at home for two weeks and then came to the hospital. At the time of his admission the joint was distended with fluid. The superior border of the patella could be distinctly felt through the skin and gave the impression of a fracture of that bone, which, however, was disproved by X-ray examination. On dissecting a flap from the anterior wall of the joint it was found that the tendon of the rectus femoris had been torn from the superior border of the patella, and from the entire upper half of its anterior surface to a line passing exactly over the middle of the bone in a transverse direction. The tendon had retracted to a point about half an inch above the superior border of the patella and two fingers could be readily introduced into the knee-joint through this rent. The latter was filled with partly coagulated, partly fluid blood, which was removed. The two lateral ligaments of the knee-joint—the continuations of the vastus externus and internus to the tibia—were intact. The upper edge of the torn tendon was dissected out and brought down to the lower edge, running across the middle of the patella, and united to it by interrupted chromic acid sutures; complete closure of the wound without drainage. This was six weeks ago. The patient can bend his knee almost to a right angle, and also extend it. The speaker said this was the second case of rupture of the quadriceps tendon he had observed, the first coming under his care many years ago and involving the upper end of the tendon of the rectus femoris—the rarer variety. In the case presented to-night there was not a trace of tendon tissue left on the upper anterior half of the patella and the speaker had to content himself with suture of the thin layers of tissue that pass over the anterior surface of the patella to the ligamentum patellæ. Evidently this weak suture had been sufficient to hold the tendon in place until also its posterior surface had become firmly united to the denuded surface of the patella.

Dr. Willy Meyer said that two cases of rupture of the quadriceps tendon had come under his care, one of them being bilateral. The first patient was a man eighty years of age who, in getting out of the bath-tub, slipped and ruptured the quadriceps tendon on both sides, but not so severely injuring the capsular arrangement of the knee-joint as in the case presented by Dr. Kammerer. In view of his age, he was opposed to operative treatment. The extremities were simply placed in splints, after bringing the parts in the best apposition possible with adhesive plaster, figure-of-eight. Centrifugal massage of the muscles was then instituted, so as to always bring the parts downward to the patella. The rupture had happened about half an inch from the upper end of the patella. The man made a good recovery, and later used his limbs perfectly for several years.

In the case of the other patient, the joint was opened, and revealed a far-reaching rupture. The ligamentous apparatus was carefully stitched up and the tendon brought down to the patella and sutured with a couple of sutures. The patient recovered with good function of the leg.

CYST OF THE HUMERUS

Dr. Frank S. Mathews presented a boy, thirteen years of age, who was admitted to St. Luke's Hospital in January with a fracture of the lower portion of the humerus. The boy had had a very slight trauma, having fallen while walking on the sidewalk. It was learned, however, that he had had pain in the limb all winter. X-ray revealed the cyst and fracture. An incision was made, and on reaching the bone the cortex was found to be as thin as paper. The cyst contained an old blood clot, but in the lower portion there was solid tissue which was reported by the pathologist to be osteitis fibrosa. A bone splint was inserted and fairly firm union had resulted.

Several pictures were presented, in some of which an amount of new bone could be seen. The most interesting picture showed the bone splint surrounded by new bone.

Dr. Mathews said that the bone splint would probably be absorbed. This was the first case of the kind he had ever operated on. The bone splint was inserted because it was feared that there might be considerable shortening. The splint was taken from the anterior border of the tibia, and included the periosteum.

Dr. F. Kammerer recalled a case, which he had shown to the Society many years ago, of fibrosis of the femur in a man in middle life. The latter had sustained a spontaneous fracture of the thigh in its lower third two years before he came under the speaker's care, which

apparently was firmly united when he was admitted to the hospital with a second spontaneous fracture in the upper third of the same femur. When the medullary cavity of the shaft was opened at the site of this fracture a large amount of fibrous tissue, completely filling it, was removed. After a stormy convalescence the second fracture also became firmly united, but considerable deformity of the limb resulted. The patient when last seen, some years ago, had not again fractured the bone.

TRAUMATIC EPILEPSY: IMPLANTATION OF FASCIA AND FAT GRAFT INTO DURAL DEFECT

DR. JOHN DOUGLAS presented a patient, a young negro man, twenty-six years of age, who had been struck with a hatchet on the left side of the head on January 6, 1913, causing a compound depressed fracture of the skull in the left parietal region. Following the blow, he remained unconscious for one hour and on regaining consciousness found that his right arm and the right side of his face were paralyzed. He was operated on for elevation of the depression nine days later, and his paralysis gradually disappeared about two weeks after the injury.

Seven months later, in August, 1913, he had an attack of twitching in the right side of his face and right arm. The next attack was in February, 1914, when he also became unconscious. Subsequently, up to his admission to St. Luke's Hospital in September, 1914, he had similar attacks about once a month, seven in all. Examination showed a depressed scar in the right parietal region, over the motor area of the arm and face.

An osteoplastic flap was turned down, revealing an area of deficient bone along the line of fracture, with the dura replaced by scar tissue, which was adherent to the cortex. A small fragment of bone was seen sticking through the dura into the cortex. This was removed, as it was believed to be the cause of the twitching and convulsions. The exposed cortex was covered with silver foil and the flap was replaced. The wound healed readily, and the patient left the hospital in a little over two weeks.

Shortly after leaving the hospital, he again began to have convulsions, more severe and oftener than before. He returned to the hospital, and a second operation was performed, turning down the same osteoplastic flap. The old scar tissue along the line of fracture was found to be adherent to the cortex, the silver foil had become rolled up, and an area of dura 1½ by 3 cm. was replaced by dense connective tissue, showing that the idea that the convulsions were due to the small

piece of bone was probably wrong and that they were more likely caused by the adhesions of the cortex to the wound area. A piece of fascia lata was removed from the leg, about 2½ by 4 cm. in size, with ½ cm. of fat attached to the outer surface. All the scar tissue was stripped from the cortex until healthy dura was exposed at the edges, and the fascia lata graft was applied with the fat surface in contact with the cortex and the edges sutured with fine catgut to the healthy dura. The osteoplastic flap was then turned back. The wound healed by primary union. That was on December 4, 1914.

Immediately subsequent to the operation, the patient had some twitching of the right arm and the right side of the face (after the first operation, he had had some paralysis in the right arm and right side of the face). Since the second operation, five months ago, the patient has had no further convulsions, although it is too soon to consider that a permanent cure has been attained.

Several materials have been used in similar operations since the celluloid or metal plates were first employed to replace a deficiency in the skull and prevent adhesions to the cortex. Finsterer and Perthes have used hernia sac; Hanel has used prepared sheep intestine; Morris, Cargile membrane; Kirschner has reported seventeen cases in which he used fascia lata, after removing all the fat; Lexer employed a non-pedunculated fat-flap to prevent adhesions between the brain and scalp; and Binnie has reported a case in which he used a flap from the abdominal wall. The idea in this case was that the fascial flap alone would be more apt to reform adhesions to the exposed cortex than one in which the fat could be placed next to the cortex itself, the strong fascia lata replacing the fibrous portion of the dura and acting as a protection.

Dr. Wm. A. Downes said that he had seen Dr. Douglas put in this flap, and shortly afterward had a similar case, except that there was a bony defect 2 by 3 cm. On the first of January he had raised the scalp and found it adherent to the cortex. It was dissected off, and a fascial flap with its fat was inserted. The man had one convulsion the second day, but had had none since. The time, four months, was too short to draw any conclusions.

Dr. Geo. Woolsey thought it quite possible that in Dr. Douglas' case the recurrent epilepsy might have been due to the adhesions and the original epilepsy to the spicule of bone, and cited a somewhat similar case in which all that he had done was to remove the spicule. The patient had been operated upon, and on reopening the skull a spicule of bone projecting through the dura was found surrounded by a small

cyst. The last time he had heard of the patient, some years later, he was entirely well. He had had convulsions during the post-operative period, for at that time hammer and chisels were used and there was a good deal of trauma. In two cases this winter he had used the fascial flap, not having so much fat on the flap as Dr. Douglas had had. It was too early yet to say what the result would be. One patient had been previously operated upon by himself and a piece of celluloid inserted. The result as far as the epilepsy went was good. The reason of the second operation was that overlying the celluloid, between it and the scalp, there was a collection of fluid which caused a marked bulging of the scalp. There was no infection, and underneath the celluloid there was no fluid. The other case had a large area extending well down beneath the temporal muscle from near the midline, so that a long narrow fascial flap had to be used.

Dr. Willy Meyer said that some time before he had presented to the Society a young man with an old compound fracture of the skull, followed by traumatic epilepsy. After trephining, the adherent dura was freed and a piece of celluloid implanted. It healed in nicely. Two years later, epileptic attacks returned. The skull was re-entered and it was found that the large celluloid plate had healed in perfectly. It was removed and the motor centre of the arm resected, and the plate was re-implanted; that also healed, but the patient was not cured of the epilepsy. Certainly, the recent method of transplanting the fascia is preferable to heterogeneous material.

ECHINOCOCCUS CYST OF KIDNEY

Dr. Wm. A. Downes presented a man, forty-nine years of age, who for fifteen years had complained of pain and a mass in his left side. The condition had been variously diagnosed as due to spleen or kidney, but barring one or two attacks of some discomfort the patient had had no serious trouble up to two years ago, when the attacks became more frequent and the large mass interfered with his going about and attending to his business. He was admitted to St. Luke's Hospital, April 6, 1915. Examination showed a smooth, non-fluctuating mass filling the entire left side of the abdomen. Catheterized specimens of urine from kidneys: left, alkaline, pus, trace albumen, urea much diminished; right, acid, no albumen, urea normal. Culture negative. Urinary flow: right, normal; left, rapid. Blood examination showed no eosinophilia. Operation, April 13: Transverse kidney incision. Kidney found to be seat of thick-walled cyst which was very adherent and was separated from the descending colon with difficulty. Convalescence slow, but entirely satisfactory.

RESECTION OF STOMACH THROUGH TRANSVERSE INCISION

DR. WILLY MEYER presented patients for whom stomach resections had been made through a transverse incision. For description of these cases and discussion of the operative method, see page 573.

WIRING OF PULSATING TUMOR OF THE CHEST

DR. WILLY MEYER presented a man, who for two years had been under the observation of Dr. J. G. W. Greeff, of the German Hospital. An account of the case would soon be published by him. The latter first saw the man in 1913, when the patient complained of shortness of breath, but said that he had suffered from that for four years; he had, however, of late been suffering with increased pain in the chest. At that time he weighed 180 pounds. On examination, the left lung was found to be normal. Over the right there was hardly any breathing sound. Only near the diaphragm was a zone of normal percussion. On account of the flatness, he was aspirated, but this was negative. Vocal fremitus was diminished. An X-ray picture was taken and a large shadow found over the right portion of the chest; the heart had been pushed to the left, and it was reported that there was either blood or fluid in the chest.

The patient was seen again in September, 1913. He had then lost in weight. At that time, one year and eight months ago, there was found a small pulsating tumor in this region. It appeared penetrating the fifth cartilage, also between the fourth and fifth rib interspace. There was no history of lues. The man had run down to 145 pounds.

He was admitted to the German Hospital.

In this case, at first glance, one would diagnose aneurism, but there was no thrill present, though there was distinct systolic expansion, and the diagnosis of aneurism could not properly be made. The condition went on for a year and some months, without any tendency toward improvement. To make things sure, aspiration was done at the base, and arterial blood was found. It was explained to the patient that in order to do what was best the tumor should be wired according to the method that has been so thoroughly worked out by Lusk. The only objection to Lusk's method is the preparation of the wire. In one case presented by the speaker about a year ago, it took the house surgeon and another man sixteen hours to prepare the wire. Having showed the patient before this Society, the speaker consulted with Dr. Kauffer, a dental surgeon connected with the Harlem Hospital, as to whether or not one could improve on the preparation of the wire. In two weeks he reported that he had found an improved method. He winds the

wire around a bottle of proper diameter, and covered with asbestos. Then an electric current is sent through, and the wire brought to red heat. After cooling, it retains its shape. Sixteen days ago, with the needle introduced under local anæsthesia, forty-five feet of wire were fed in, and then the electrolysis started. It takes one hour. The patient stood it nicely, and on the whole he seems to be improved. Formerly, he could sleep only in a certain position, and had to take morphine. Now he takes only half the former quantity, and can lie any way. He was brought down to show this new method of preparing the wire, which is an important advance over former methods.

The X-ray plates nicely show the coils of wire in a large cavity within the chest, hardly any in the tumor, projecting above the surface of the chest.

FINAL RESULT OF ARTERIOVENOUS ANASTOMOSIS (FEMORAL) FOR GANGRENE OF FOOT

Dr. Willy Meyer presented a man who he said had been shown to the Society some two years previously. The trouble began on the right foot, and at last healed, when the same trouble developed on the other foot. The man suffered so that he could not sleep at night. Operation was indicated, but not wanting to amputate and not knowing of anything else that could be done, arteriovenous anastomosis was performed, in the presence of the gangrene which he had at the base of the great toe, involving the metatarsal bone, considered to give a bad prognosis. A typical Carrel operation was done, exposing the vessels and ligating one side; an end-to-end anastomosis, which Dr. Meyer prefers to lateral anastomosis. The patient had so much pain following the operation that nine days later the necrotic bone was removed, of course without any Esmarch's bandage. To every one's surprise, there were then a number of vessels bleeding so freely that ligatures were required. From that time on, the patient's pain lessened. To-day, the patient was in splendid condition and able to attend to business.

THE CONSERVATIVE TREATMENT OF GANGRENOUS PROCESSES OF THE EXTREMITIES

Dr. Willy Meyer read a paper with the above title.

TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting, May 3, 1915.

The President, Dr. John Gibbon, in the Chair

RESULT OF LATE NEURORRHAPHY

Dr. Edward B. Hodge presented a girl who had been in the Widener Memorial School, under treatment for tuberculosis in the left knee-joint. During her stay in the School she fell from a small express wagon and sustained a bad compound supracondylar fracture of the right humerus. A good result was obtained with the arm in Jones' position. During the treatment it was found that she had complete wrist drop. There was complete paralysis of the musculospiral nerve. This was treated expectantly and three months later Dr. Willard cut down upon the nerve, finding it contused but apparently not severed. No improvement in function followed. In January, 1914, 5 years after injury, the speaker cut down upon the nerve, traced it down and found that it had been completely sheared through, the proximal portion continuing past the elbow as a fibrous cord. The distal portion of the nerve was buried under muscle and adherent to the humerus below the fracture. After reaching into normal nerve tissue, the ends were united with 2 silk sutures with the elbow in acute flexion to relieve tension. Later a cast was applied with the wrist hyperextended and still later massage and passive motion employed. At the end of ten months some improvement was shown, and now at the end of a year and a half there is pretty fair power. She has nearly complete power in extension of the wrist, good supination, and everything but complete extension of the fingers. The case was reported to encourage late attempts at neurorrhaphy. At the time of operation, there was partial reaction of degeneration in the muscles involved.

OLD POSTERIOR DISLOCATION OF SHOULDER

Dr. Hodge presented a young woman who had been the subject of a posterior dislocation of the shoulder of unusual etiology, which had become replaced in an unusual manner. The shoulder was luxated either from receiving a blow with a broom in sweeping, or in the motion of putting the hand to the head to do up her hair. This was followed by complete disability, swelling and pain. Dr. Hodge saw

the patient at the end of five or six weeks. The arm was swollen and painful and there was almost complete disability. Below the acromion there was a considerable gap, the elbow was against the chest and forward, the head could not be felt in the axilla. A series of skiagraphs demonstrated a posterior dislocation below the acromion. An effort to obtain reduction under ether was about to be made, when during the anæsthetization the nurse who was holding the patient's hand left it for a moment to attend to a detail of the service and the arm dropped off the edge of the table. When Dr. Hodge grasped the arm to manipulate, he found the head already in the glenoid. Dr. Wharton was in the next room at the time and he confirmed the reduction. The patient has had complete comfort since though she has greatly limited function.

END RESULTS IN FRACTURES OF BOTH BONES OF THE LOWER EXTREMITY

Dr. Rutherford L. John, by invitation, read a paper with the above title, for which see page 619.

Dr. George C. Ross, in connection with extension by the Steinmann nail, asked whether any of the Fellows had used a method for extension in this type of fracture when the fracture is so close to the ankle that the limb cannot be put in a box. The device consists of an old shoe with the heel and toe cut out. To this a piece of heavy cord is attached bearing 20 to 25 pounds weight. The shoe is laced around the man's ankle. This makes satisfactory extension and if persisted in gives very good results.

Dr. John, in closing, said that the measurements were made from the lower border of the patella to the internal malleolus in all the cases. The old shoe method suggested by Dr. Ross is valuable in quite a number of cases except where there is much œdema of the foot, under which condition there is considerable danger of sloughing. In the presence of possible sloughing a heavy felt placed over the instep before the shoe is laced up is of advantage. The Steinmann nail, however, obviates this danger (of sloughing) and causes no pain to the patient while it is in use.

FRACTURES OF THE FEMUR, WITH END RESULTS IN SIXTY-TWO CASES

Dr. Carl R. Steinke read a paper with the above title, for which see page 610.

Dr. A. P. C. Ashhurst said it is surprising to find, in these two

series of fractures of the leg bones and of the femur, that there is very little difference in the period of disability. One is apt to think of a longer period of disability following fractures of the thigh than those of the leg. He had recently been going over hundreds of case reports of fractures for the American Surgical Association, and had found that the period of disability in all fractures was much longer than is commonly supposed. Such results are not very creditable. It is only by studious and painstaking investigations such as these of Dr. John and Dr. Steinke that one is able to realize that the patients are by no means cured when they leave the hospital, but that often a long period of disability follows. It should be the object of surgeons not only to get good functional results, but to get such results in as short a time as possible.

Dr. John B. Roberts said that what Dr. Ashhurst had said was perfectly true and the reason is perfectly plain. Surgeons do not get good results in fractures of the lower extremity because most of these cases are put to bed and are not given mobilization early and massage all the time as is more apt to be done in fractures of the upper extremity. There are many illustrations to be found showing how few cases of fractures of the lower extremity are properly taken care of by orderlies, nurses and resident physicians; whereas, similar injuries of the upper extremity are more apt to be seen not only by the resident physician, but also by the chief. A study of the results reported by the British Fracture Committee and the reports of the Committee on Fractures of the American Surgical Association, shows that the great faults in the treatment of fractures are (1) want of anæsthesia and reduction; (2) want of early mobilization and gentle massage. It is not only the fractured bone that needs treatment always; but also the soft parts surrounding and near the bone. The neglect of the soft parts is largely responsible for many poor functional results. He had in his possession a series of pictures and clinical reports, obtained some years ago, in which there is very great anatomic deformity according to the photographs and X-ray prints, but good functional result. These patients were treated by men who believed in early mobilization and massage, but did not pay as much attention to the anatomical reconstruction of bones at the point of fracture as many American surgeons are accustomed to do. The great defects in treatment of fractures of the lower extremities have been, neglect of reduction under general anæsthesia, poor attention to the soft parts, and the want of proper early mobilization and light massage from the very beginning,—light massage, not the vigorous motions and knead-

ings used by the average graduate of a massage school for lazy manhood and overfed women. The fragments should first be put in place under anæsthesia, and then the soft parts given as much attention as surgeons have usually given to bad sprains and formerly gave to the bones alone in fractures which they personally treated in private practice. Such methods will greatly lessen the need for direct metallic fixation of broken bones. Post-graduate teaching should emphasize the non-operative treatment of fracture and hospitals should provide proper ward service for these injuries.

Dr. Gwilym G. Davis emphasized the point to which Dr. Ashhurst had called attention, namely, the period of cure, particularly in relation to the question of treatment. The charter of most hospitals requires that a person must be admitted to the hospital if application is made within twenty-four hours of the injury. The treatment of fractures by operative means is probably the result of the effort to shorten the period of disability. This attempt is going to be more definitely emphasized on account of the passage of the workmen's compensation act. There should be more definite means of treating patients after they have been discharged from the general hospital and have become walking patients until the time they are again able to resume work.

SARCOMA OF THE CLAVICLE AND THE SCAPULA

Dr. A. Bruce Gill reported the following case which occurred in the orthopædic service of Dr. Ashhurst at the Episcopal Hospital.

A woman aged fifty-one years presented herself complaining of a lump on her left shoulder and of pain in the shoulder, particularly on motion. The mass had first appeared about 4 weeks before her coming to the clinic and had gradually increased in size. For 2 years prior to her admission she had been having pain in her left shoulder on motion of the arm. This pain was sharp, paroxysmal, and was referred down the arm. It was relieved by heat and increased by massage and motion. The patient could ascribe no cause for the pain and the appearance of the tumor and stated that she had never suffered any injury to the arm or shoulder.

She was admitted to the Hospital on July 28, 1914. She was pale and poorly nourished and had been losing weight. On the top of her left shoulder in the neighborhood of the acromioclavicular joint was a mass about 1½ inches in diameter, rounded, soft, fluctuating, slightly red and warm, and slightly tender. It was not painful except on motion of the shoulder when the pain became severe. The X-ray plate (Fig.

FIG. 1.—Sarcoma of clavicle.

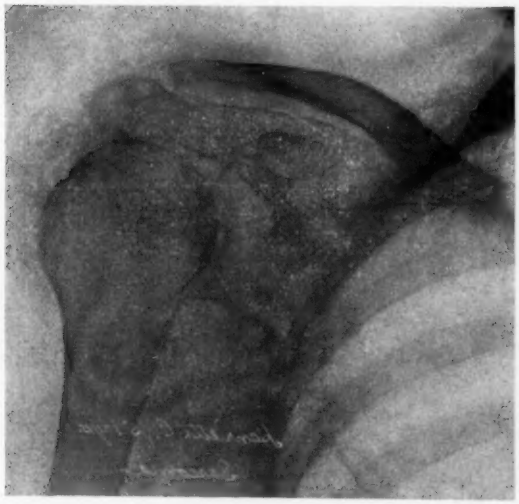

FIG. 2.—Sarcoma of clavicle, four months after first operation.

FIG. 3.—Recurrence three and one-half months after first operation (November 5, 1914).

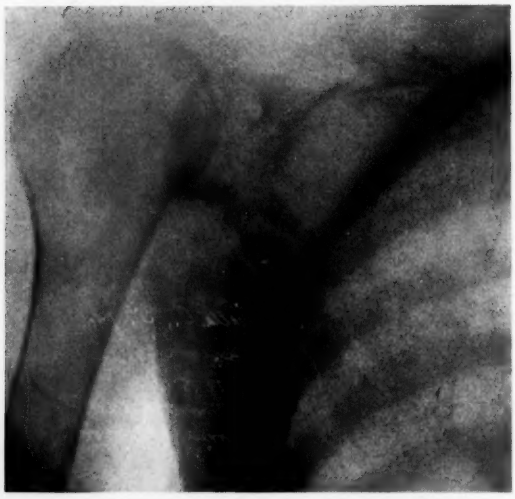

FIG. 4.—Sarcoma of clavicle, after excision of outer end of clavicle, acromion and coracoid.

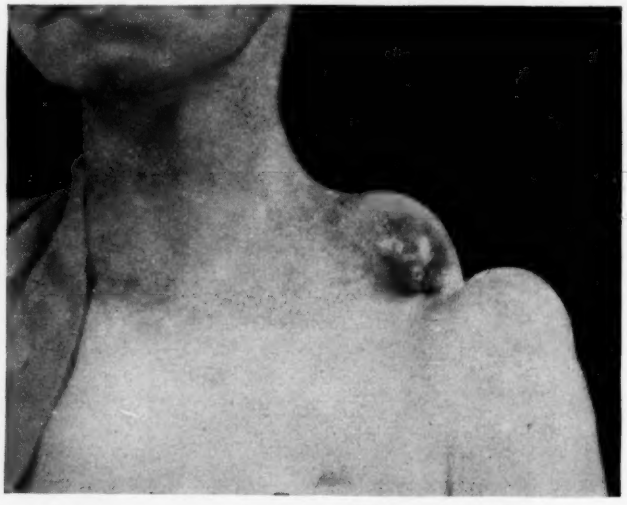

FIG. 5.—Recurrence three months after second operation (February 8, 1915).

1) showed a mass about the acromioclavicular joint with possibly slight atrophy of the acromion and the acromial end of the clavicle. A tentative diagnosis of tuberculous abscess was made.

Operation was performed on July 29, 1914, by Dr. Gill. A curved incision was made in front of the tumor and a skin flap dissected upward. The tumor lay close beneath the skin and was soon penetrated. A mass of soft tissue resembling a soft blood clot in consistency but grayish in color oozed out abundantly. Hemorrhage was quite free. The tumor mass was cleaned out as thoroughly as possible with finger, sponges, and curette. It seemed to be enclosed in front, at least, by a thin capsule lined with large veins. The lower surface of the acromial end of the clavicle felt roughened. Otherwise there appeared to be no other bony origin of the tumor. Bleeding was controlled by packing tightly with iodoform gauze and a few sutures were placed to close the incision in part. Diagnosis was made of sarcoma of the clavicle. Microscopic section of the tumor showed it to be of the spindle-celled variety.

The use of Coley's fluid was begun shortly after the operation and was continued in ascending doses until considerable reaction was produced. The wound healed on August 18, 1914. But in less than 2 months the tumor gave evidence of recurrence (Figs. 2 and 3). On November 7, 1914 Dr. Ashhurst operated and removed in one mass a third to a half of the clavicle, the acromion, and the coracoid process together with the surrounding soft tissues. More of the deltoid and trapezius muscles were then removed until no evidence of tumor remained. The skin was approximated and sutured with the arm abducted to a right angle.

The use of Coley's fluid was continued, and the wound was healed by December 19, 1914 (Fig. 4). About the middle of January the tumor appeared to be recurring in the trapezius and the scapula.

On February 8, 1915 the tumor appeared as shown in Fig. 5. At this time the mass was dark in color, owing to hemorrhage within the tumor substance. She was readmitted for operation. Spontaneous rupture of the tumor occurred after her admission and about a pint of blood was lost before the hemorrhage could be controlled by packing.

On February 17, 1915, Dr. Ashhurst performed the third operation consisting of complete excision of the scapula with the exception of the lower angle and the glenoid, and of the trapezius half way to the occiput. Very little hemorrhage occurred owing to the fact that the line of incision was carried wide of the tumor. Part of the clavicle was removed although it did not appear to be involved in the tumor. The brachial plexus was freely exposed, but was not injured in the operation.

The skin was approximated and sutured again with the arm in abduction.

The patient failed to recover consciousness after the operation and died three hours later. Autopsy showed sarcomatous metastases in the lungs.

Coley has reported 10 cases of sarcoma of the clavicle. Of these 8 gave a distinct history of antecedent trauma. In the case recorded above there is no such history. Coley in his report (ANNALS OF SURG., 1913, p. 556) of a case discusses the literature briefly and confirms his conclusions expressed in 1910 that:

1. Primary sarcoma of the clavicle is one of the most malignant of all neoplasms.
2. While a rare condition, it requires early diagnosis and very radical treatment.
3. The mortality of the operation itself should be small.
4. The danger of local and general metastases is very great.
5. The use of Coley's fluid is strongly indicated as a routine measure immediately after operation.

GIANT-CELL SARCOMA OF PELVIS

DR. GUY BLAIR DENIT reported the case of a lad, fourteen years of age, who was admitted to the Orthopædic Hospital under the care of Dr. A. P. C. Ashhurst. He was complaining of severe pain in the right hip and small of the back. Six weeks previously he had strained his back by lifting one end of an elevator weight, weighing 300 pounds. That night he suffered severe pain in his back radiating from the lumbar region to the right hip. In several days the pain ceased. One month later, while playing at school, he was knocked down and struck his right lumbar region against a stone wall. This caused him much pain and he was taken home and put to bed. He remained in bed for a time, and then on crutches until December 1. On December 1 he was taken to a hospital and treated for rheumatic arthritis of the right hip. He was admitted to the Orthopædic Hospital on December 28. On admission he was suffering with severe pain in the right lower quadrant of the abdomen and in the right hip. His pain was paroxysmal in character, lasting an hour or more at a time. He was a fairly well nourished boy about average size for age.

In lumbar region on the right side there was a large mass, semisolid in consistency, occupying the whole of the right lumbar region and right lower quadrant of the abdomen. On palpation this mass was extremely tender.

An incision was made through the bulging mass in the loin, and a

portion of the tumor was excised and sent to the laboratory for examination. The wound was sutured and drained without further operative procedure.

One specimen of the tumor was examined by Dr. C. Y. White, director of the Pathological Laboratories of the Episcopal Hospital, and another by Dr. E. P. Corson White, Pathologist to the Orthopædic Hospital. The report from both laboratories was that the tumor was a giant-cell sarcoma.

Matthew J. Stewart (*Lancet,* ii, 1236) gives the following classification of giant-cell sarcoma: " Giant-cell sarcoma is used in its widest sense as a term to include all sarcomata in which giant-cells of blastomatous origin constitute an important part, it may be the essential feature of the microscopic picture. This large class is made up of two groups of cases: (1) the myeloid sarcomata (myelomata of some authors) and (2) the malignant giant-cell sarcomata. The latter are equivalent to mixed-cell sarcomas, as there are cells of all sizes, but in some the giant-cells are so numerous as to justify special recognition in the term used. Giant-cells of the myeloid sarcoma resemble osteoblasts and clasts, not myeloplaxes or mononuclear giant-cells or bone marrow. Cytoplasm is abundant especially at periphery and presents a homogeneous ground glass appearance. Vacuoles mostly peripherally situated are often present and may be of large size when they not infrequently contain cell inclusion. The nuclei are uniformly small in size and when not closely packed together are round or oval in shape. There are no mitoses in these giant-cells even when mitoses are present in cells forming matrix of the tumor. The nuclei in smaller giant-cells and in many of the larger are uniformly distributed through the cytoplasm, but in larger giant-cells they often are grouped in the centre in 'whorls.' The peripheral ring-like distribution of the nuclei, so characteristic of tubercular giant-cells, is practically unknown in cases of myeloid sarcoma. N. B. There are no transitional forms between the giant-cells and other cellular constituents of the growth, every cell is either a giant-cell or not a giant-cell without any doubt whatever.

" In malignant giant-cell sarcoma, as in myeloid sarcoma the stroma may be round, spindle or mixed celled, and as in it the number of giant-cells varies greatly in different parts of the same growth. Cells of the stroma are very irregular and almost always one can find transition forms from smallest to the largest. Mitoses are very frequent both in giant-cells and in the matrix. The giant-cells and especially their nuclei are the chief distinguishing characteristics. The nuclei are extremely irregular in size and shape, often presenting lobes and indentations while most of them are of large size. Enormous nuclei may

be met with and the giant-cells may be mononuclear. The number of nuclei seldom exceeds six, and most cells have from one to five only. Usually they are clumped together and it may be difficult to count them precisely. Vacuolation of cytoplasm is rare."

The tumor in this case belonged to the first group of cases, the myeloid sarcomata.

On January 22, three weeks after the operation the first injection of Coley's fluid was administered. The first injection, 1/10 minim, was given into the buttocks. Seventeen weeks after the beginning the dosage had been gradually increased until minims 42 were being given. At no time during these weeks were the reactions severe. He was then given a rest from treatment for a period of three weeks, at the end of which time the injections were resumed, beginning with minims 42 and gradually increasing the dosage until minims 48 were being given. Again he was given a rest over a period of three weeks, at the end of which time the injections were resumed, beginning with minims 48. From this time on the reactions were rather severe, the temperature often going above 102° and at times reaching 103.2°. Chills accompanied the temperature and there was always severe pain at the site of the needle puncture.

The injections were discontinued on September 18, 1914, eight months after the beginning of the treatment, at which time he was given minims 56. This caused a severe reaction, the temperature going up to 103.8°, and a severe chill accompanied the temperature. However, his condition was at no time alarming.

As stated before, the injections were given over a period of eight months with only six weeks rest from treatment. As a rule these injections were given every other day; however, three or four days often elapsed between injections.

The fluid was first injected into the buttocks. First on one side and then on the other. They were then given nearer and nearer the tumor until the tumor in the loin itself was injected. There was always severe pain at the site of the needle puncture and often marked skin reactions. The constitutional reactions were on the whole very mild, but at times they were rather severe. At no time was it necessary to give stimulants, but morphine, codeine and aspirin were frequently given for the relief of pain. At no time were the injections given daily. Twice the patient was given a rest of three weeks from treatment, during which time his general condition improved a great deal. The bowels were always kept open and tonics were given at intervals during the treatment. The injections were given deeply in and around the tumor in the loin and at no time were the reactions so severe as to cause alarm.

The directions as prepared by Dr. Coley were followed except as to dosage; as stated before, the first injection was minim 1/10, and the highest dosage was minims 56, this being, so far as I can find out, the highest dosage of the fluid that has ever been administered. In a recent letter received from Dr. Martha Tracy, of Germantown, Phila., whose preparation of Coley's fluid was used, she states that the highest dosage that has been administered by Dr. Coley himself was minims 26, but states that she knows of one surgeon who has given as high as minims 30. She further states that Dr. Coley believes there are few cases in which minims 26 would be safe. In a statistical study prepared by Dr. Tracy she finds about ten per cent. of the cases of sarcomata in general are benefited by the treatment.

Results of the treatment. As to the actual time in which the tumor began to diminish in size it is somewhat difficult to state owing to the position of the tumor. However, there was marked diminution in the pain two weeks after the first injection, at which time the patient was allowed to sit up several hours daily. Soon after this he was able to walk around the ward without discomfort, but he had a distinct limp on the right side. There was always a local reaction at the site of the tumor when the injections were made into it. This mass retained its somewhat semisolid consistency until the last of September, at which time it began to become softer and softer and increased in size. Several days later the mass broke down and discharged through the scar of the incision in the loin. From this time the mass in the loin diminished in size and became harder and harder in consistency and at the time the injections were discontinued the mass had the consistency of a bony tumor. This tumor seemed to be adjacent to the fourth and fifth lumbar vertebræ in the right loin.

The patient was discharged November 10, 1914. He had none of the symptoms which were so prominent on admission. No tumor could be palpated through the abdominal wall, the mass in the loin had decreased in size and assumed the form of a bony tumor. There was no pain on walking or running. His general health had improved a great deal. A skiagraph taken at this time shows a small tumor adjacent to the fourth and fifth lumbar vertebræ.

On December 1 the patient was readmitted to the Hospital for examination. There was no sign of an increase in the size of the tumor. There had been no return of pain or lameness. A skiagraph taken at this time shows the tumor to be about the same as at the time of his discharge in November.

At the present time the patient goes to school, he rides a bicycle, plays base-ball and has no difficulty in running and playing. There

has been no return of pain. He now weighs 103 pounds; while at the time of his discharge he weighed 76½ pounds. A skiagraph taken May 1, 1915, shows that there has been no change in the size of the tumor since his discharge in November, 1914.

DR. A. P. C. ASHHURST called attention to the marked contrast between the cases reported by Dr. Gill and by Dr. Denit, the former a typically malignant sarcoma, and the latter a so-called giant-cell sarcoma. In both the tumor was curetted, and the patients were treated by Coley's fluid. In both patients, likewise, the tumors recurred after operation in spite of this treatment. But in the case of the woman (Dr. Gill's case) death followed the operation for the second recurrence, only 7 months after the first operation; while in the boy (Dr. Denit's case) the recurrent tumor gradually melted away under the influence of the toxins, seemed to become more and more bony, and the patient is at present apparently in perfect health, more than 7 months after cessation of treatment, and 17 months after the first and only operation.

As to the real nature of giant-cell sarcomas, many papers have been written by surgeons setting forth their views; but the pathologists really are wiser, for like Socrates they admit that they know nothing. In the *Lancet* some months ago is a paper by Stewart (*Lancet*, 1914, ii, 1236), the Clinical Pathologist at the Leeds General Infirmary, based on a study of about 50 cases of giant-cell sarcoma. He concludes that the benignancy or malignancy of the tumor can be predicated absolutely upon the characters of the giant-cells present; whereas it is Bloodgood's contention that it is the stroma which is especially characteristic, and that in the benign growths it resembles granulation tissue. Then there is Barrie of New York (ANNALS OF SURGERY, 1913, i, 244) who goes still further, claiming that it is really granulation tissue, and calling the disease hemorrhagic osteomyelitis.

AN ANATOMICAL STUDY OF FEMORAL HERNIÆ

DR. T. TURNER THOMAS read a paper with the above title, for which see page 582.

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